

Table of Contents

<u>Symbols</u>	1
<u>Foreward</u>	2
<u>General Information</u>	2
<u>Section 1 – Control Functions</u>	3,4,5
<u>Section 2 – Theory of Operation</u>	6
<u>Section 3 – Circuit Description</u>	6,7,8
<u>Section 4 – Service Information</u>	9
<u>Section 5 – Suggestions for First-Time Operation</u>	9,10
<u>Section 6 – Removal and Replacement Procedures</u>	10
<u>Section 7 – Safety and Performance Checks</u>	11,12
<u>Section 8 – Problem-Solving</u>	12,13
<u>Section 9 – Calibration</u>	13,14
<u>Section 10 – Maintenance</u>	15
<u>Section 11 – Warranty</u>	16
<u>Section 12 – Repair Return Policy</u>	16
<u>Section 13 – Specifications</u>	17,18
<u>Section 14 – Drawings and Schematics</u>	18

Symbols



CAUTION: To reduce the risk of an electric shock, do not remove the back cover of the instrument. To retain memory of the previously used power setting, 115, 215, 230, 245 VAC line power is supplied to the instrument while it is plugged into a hospital grade wall receptacle.

CAUTION: The Hyfrecator Plus 7-797-J is wired for 100VAC line power and does not include the memory feature. There is no VAC line power supplied to the instrument when the ON/OFF switch is in the OFF position.



CAUTION: Site is a source of high voltage.



CAUTION: Before using instrument, read operating manual. The green, green/yellow wire of the line, which is inside the unit, is connected to the transformer housing and patient return to reduce the hazard of electric shock. Grounding of the equipment is achieved by connecting the line to a three conductor grounded hospital grade wall receptacle.



Equipment is classified as Type BF: it has an internal electrical power source that provides an adequate degree of protection against electric shock, particularly in regard to the allowable leakage current and the reliability of the Protective Earth connection. The unit is also protected against the effects of the discharge of cardiac defibrillation.

Foreword

This easy-to-follow manual is designed to assist you in the servicing of the Birtcher Model 7-797 HYFRECATOR PLUS. For basic information on how to operate or care for your unit, please refer to the operating manual that was included with the unit at the time of purchase. If you have questions, or would like personal assistance regarding how to service the unit, please call Birtcher Medical Systems' Service Department at (714) 753-9400, (800) 888-1771

General Information

Birtcher Medical Systems introduced the first Hyfrecator in 1937 and has since become the world's leader in office-based electrosurgery. With the latest model, the HYFRECATOR PLUS 7-797, Birtcher Medical Systems has refined the concept and utilized today's technology to produce the finest machine of its kind.

Safe and simple to use, the HYFRECATOR PLUS has a wide range of applications – from dermatology and gynecology to ophthalmology and urology. The HYFRECATOR PLUS' sophisticated electronic circuitry provides a near linear power output. Whether it's full power for broad surface coagulation, or low output for delicate facial procedures, the HYFRECATOR PLUS provides the precision you demand. Compatible with existing Hyfrecator accessories, such as bipolar forceps and reusable electrodes, the HYFRECATOR PLUS features an ergonomic design and contemporary style that complements modern office decor.

Section 1 – Control Functions

Front, Side and Hand Switching Pencil Controls

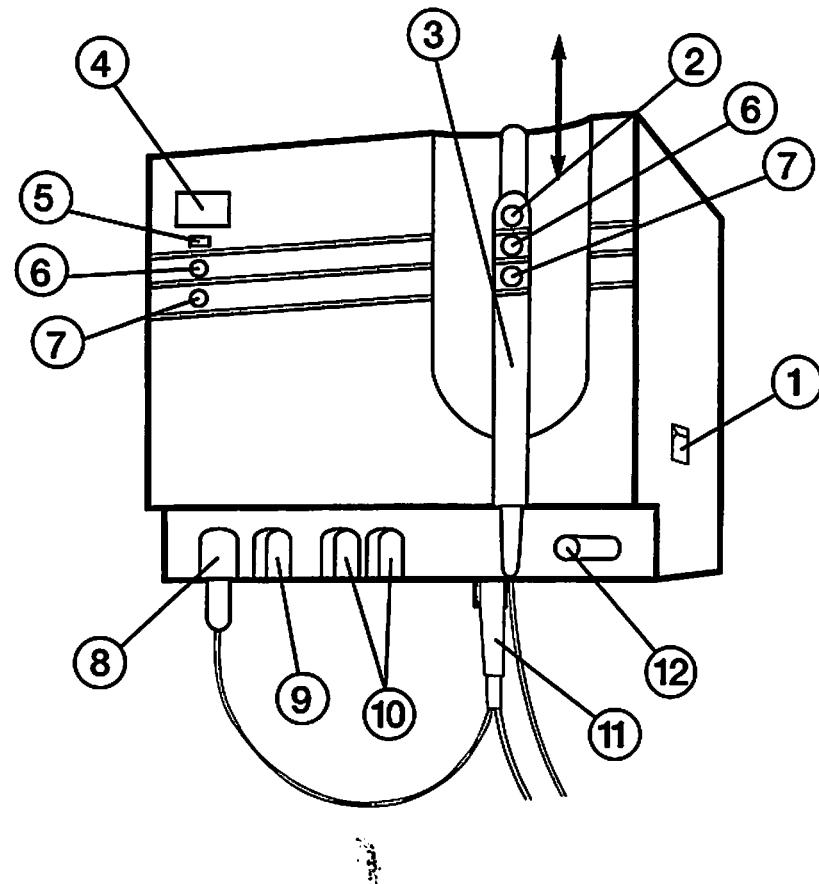


Figure 1
Front, Side and Hand Switching Pencil Controls

1. **ON/STANDBY OFF SWITCH***
Turns unit on or off. In the off mode, standby allows the unit to automatically "power up" to the setting last used.
2. **POWER ACTIVATION BUTTON**
When pressed, high frequency energy is emitted from the electrode. Additionally, an audible tone is generated and the "active" indicator illuminates.
3. **POWER UP/DOWN SWITCHING HANDLE and CORD****
Remove or insert the power handle in the indicated direction.
4. **POWER OUTPUT INDICATOR**
Displays the actual power being delivered. Power selection ranges from zero to 30 watts in high and bipolar outputs and zero to 15 watts in low output. In the low output, deliveries less than five watts are displayed in two-tenth increments.
5. **"ACTIVE" INDICATOR**
Illuminates when the power activation button is pressed.
6. **POWER UP BUTTONS**
Increases power either incrementally or rapidly. Each "click" advances the power by one watt or by two-tenths of a watt when less than five watts in the low output. Holding the button down rapidly advances the indicated output.
7. **POWER DOWN BUTTONS**
Decreases power either incrementally or rapidly. Each "click" decreases the power by one watt or by two-tenths of a watt when less than five watts in the low output. Holding down the button rapidly decreases the indicated output.
8. **HIGH OUTPUT TERMINAL**
Insert the power up/down switching handle and cord single plug into this outlet for heavy desiccation and fulguration procedures requiring high intensity. Provides between zero and 30 watts with high voltage.
9. **LOW OUTPUT TERMINAL**
Insert the power up/down switching handle and cord single plug into this outlet for light desiccation and fulguration procedures requiring low intensity. Provides between zero and 15 watts with a voltage lower than the high output terminal.
10. **BIPOLAR OUTPUT TERMINAL**
For coagulation procedures using either a dispersive patient plate or forceps. When using the dispersive plate, the plate plugs into either bipolar outlet and the handle plugs into the remaining outlet. When using forceps, the forceps plug into both bipolar outlets (a footswitch is required when forceps are utilized). Bipolar provides between zero and 30 watts with a voltage lower than the high or low output terminals.
11. **SWITCHING CONNECTOR**
The power up/down switching handle and cord socket plugs into this connector. Be sure to align the connector pins before inserting.

Note: The optional foot switch plugs into this same jack.
12. **TERMINAL SELECTOR SWITCH**
Selects the desired output terminal. Output displayed will be the last setting used (0-15 watts in low power, 0-30 watts in high and bipolar).

*The 100V Hyfrecator Plus, 7-797-J, does not include the standby feature.

**The 240V Hyfrecator Plus 7-797-B, contains a non-switching handle and a footswitch.

III. MAINTENANCE & TROUBLE SHOOTING

The system block diagram and basic circuit schematic are provided here for general review of the basic circuits that make up the Surgitron® FFPF EMC™. They should be reviewed carefully before performing any troubleshooting. Troubleshooting flowcharts are supplied for the more common problems.

The power supply includes the entry module, thermal transformer, fuses and line switch. Four high-power diodes make up the full wave rectifier. The mode selector controls the output waveform rectifier and filter. There are three options from the mode selector:

1. Fully rectified and filtered
2. Fully rectified
3. Partially rectified

They are used to perform pure Cut, Cut and Coag, and Hemo, respectively.

The RF signal network generates a 3.8 MHz high frequency signal as a carrier. This is modulated by the lower frequency signal from the mode selector.

The output power supply controller controls the output impedance matching and, therefore, controls the power output. Power output vs. load impedance test curves are included for your reference, see Fig. 3. This power intensity curve is plotted with a 500 Ohm pure resistance load.

The antenna plate provides the return path for the RF signal. The system output is controlled by operating the footswitch.

The following fault conditions are defined, along with the check procedure and the specific conditions experienced. Step-by-step procedures necessary to isolate the fault are provided so that solutions are achieved.

- A. If red AC light does not light up:
 1. Check that the power cord is plugged into the wall outlet and the other end is correctly plugged into the receptacle unit.
 2. Check fuses; do not use larger than indicated – 1.6 amp/220V or 3.0 amp/117V. Using a larger fuse will damage the Surgitron unit. Replace fuse with P/N: R-EK03A (1.6 amp/220V) or R-EK03B (3.0 amp/117V), as specified in the Surgitron FFPF EMC Repair Kit.
 3. If fuse continues to blow, remove four screws from both sides of the unit and carefully remove cover. Check for the following conditions:
 - a. Transformer short circuit – replace P/N R-EK09 (RF Safety Thermo Transformer).
 - b. Check short circuit on diode PCB or replace P/N R-EK13.
 - c. Check short circuit on R1 or replace P/N R-EK15.
 - d. Check short circuit on R5 or replace P/N R-EK16.
 4. Check AC indicator bulb; if it is open-circuited, replace P/N R-EK05A (AC Light Diode). Check the voltage output of the power entry module. If there is no voltage, replace the power entry module, R-EK17.
 5. Check secondary output voltage from transformer:
 - a. Between green wires should be >6.3V.
 - b. Between red wires should be >600V.
 - c. If these conditions are not met, replace P/N R-EK09 (RF Safety Thermo Transformer).
 6. Visually inspect the unit for shorted or burnt resistors and capacitors. Inspect wire connections and solder joints.
 7. Tube may be defective; replace P/N R-EK10 (RF Amplifier Power Tube).

B. If RF indicator does not light when foot-switch is pressed:

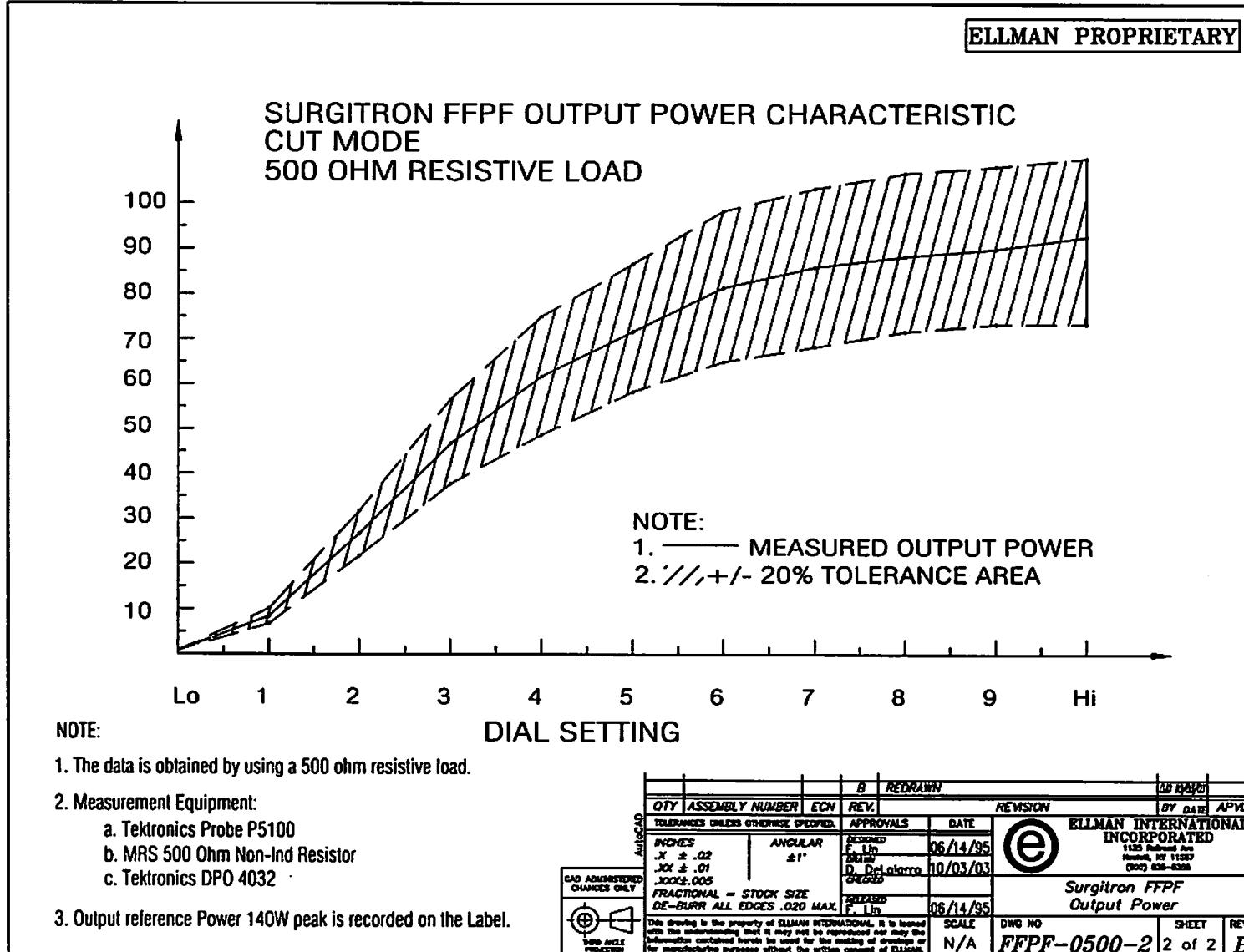
1. Allow a 15 second warm-up period before activating the unit.
2. Defective foot-switch; replace with P/N R-EK2 (EMC RF Foot Control).
3. Turn on the unit and allow a 15 second warm-up period. Visually inspect tube filament. If it does not glow (and AC indicator light is on), replace with P/N R-EK10 (RF Amplifier Power Tube).
4. Check RF light bulb. If it is open-circuited, replace with P/N R-EK14.
5. Check ground system to see if green/yellow ground wire is connected. This wire must be attached to chassis ground.
6. Check shorted or burnt components on R-EK16. If there is problem, replace R-EK16.

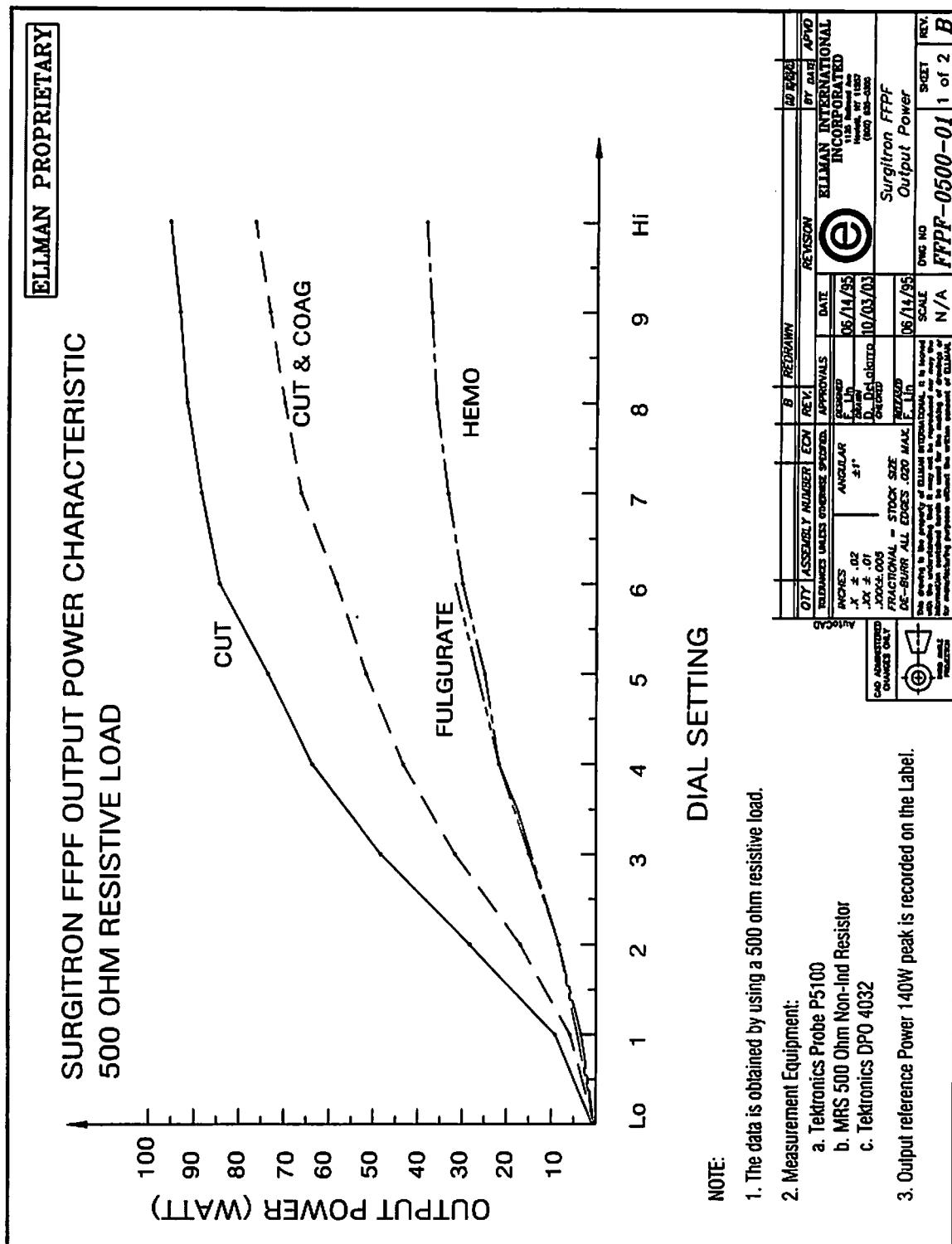
Transformer Wiring

220 VAC - the Black and the White transformer primary wires should be used.

110/120 VAC - the Black and the Black/Red transformer primary wires should be used.

100 VAC - the Black and the Black/white transformer primary wires should be used.





2. Hardware Inspection: (Visual Inspection)

a. Paint Finish	Pass_____	Fail_____
b. Labeling	Pass_____	Fail_____
	Inspector: _____	Date: _____

2.3 SECOND DEGREE INSPECTION

This test is according to UL544 Standard.

Test equipment: HIPOT tester,

1. Dielectric Withstand Inspection:	Pass_____	Fail_____
2. Ground Continuity Inspection:	Pass_____	Fail_____
3. Work Bench Practical Test: 20 Mins @ 10 sec. On/ 30 sec. Off	Pass_____	Fail_____
	Inspector: _____	Date: _____

II. QUALITY RECORD

ellman International, Inc.

3333 Royal Avenue, Oceanside, NY 11572 U.S.A
tel: (800) 835-5355, (516) 594-3333, fax: (516) 569-0054

2.1 GENERAL

a. Model: _____

b. Serial Number: _____

c. Power Supply Voltage: _____

d. Thermo Transformer Type: **MAGNET WOUND**

2.2 FIRST DEGREE INSPECTION Inspector: _____ Date: _____

(Refer to the 500 ohm load output power curve with 20% tolerance.)

Test equipment: Tektronics DPO 4032, Tektronics Probe P5100, 500 ohm Non-Inductive Load, DMM.

1. Operating Modes Inspection (Waveform inspection) and Primary Output Inspection

a. **CUT:** _____ (Check waveform with oscilloscope: Pure Filtered Wave)

Dial #	1	2	3	4	5	6	7	8	9	Hi
Power										

b. **CUT COAG:** _____ (Check waveform with oscilloscope: Fully Rectified)

Dial #	1	2	3	4	5	6	7	8	9	Hi
Power										

c. **COAG:** _____ (Check waveform with oscilloscope: Partially Rectified)

Dial #	1	2	3	4	5	6	7	8	9	Hi
Power										

d. **FULGURATE:** _____ (Only an oscilloscope is to be used for this measurement: Spark-Gap)

Dial #	1	2	3	4	5	6
Power						

ROOM TEMP.: ____ °F

ROOM HUMIDITY: ____ %

Rear Panel Controls

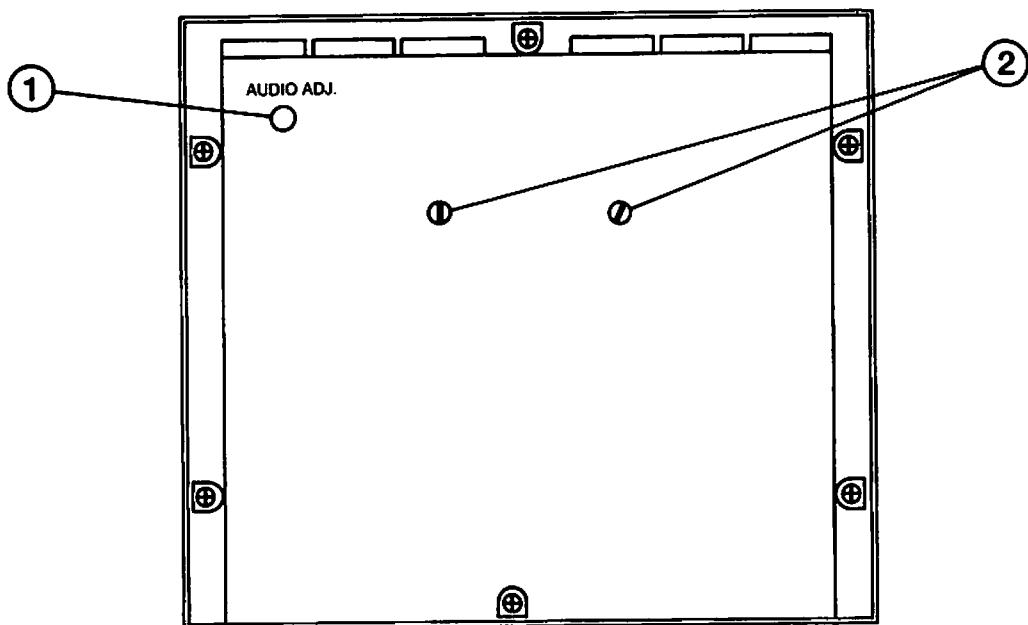


Figure 1a
Rear Panel Controls

1. **VOLUME CONTROL**

Adjusts volume of the audible tone generated when the power activation button is pressed. To increase volume, insert a screwdriver and rotate clockwise until resistance is felt. Do not force adjustment past the resistance point. For safety reasons, the tone cannot be completely turned off.

2. **WALL MOUNTING STUDS**

Used with standard wall mounting kit (see the kit for instructions). Instrument may also be mounted on the optional mobile pedestal stand (product number 7-796-1).

Section 2 – Theory Of Operation

All of the circuitry for the Birtcher Hyfrecator Plus is contained on two printed circuit boards. Board number 30-0164 contains microcontroller U56, DAC U57, 7-segment LED Display Decoder/Driver U59, 8 Bit Latch U58, DC Amplifier U52 and U53, 2MHz Amplifier U60 and gates U54 and U55. Board number 30-0165 contains the SCR Q1 and Photo-Triac A1 unregulated 55 DC volts, 15 DC Volts Regulator VR1, 5 DC Volts Regulator VR2, minus 5 DC Volts Regulator VR3, Dual D Flip-Flop U1, Comparator U2, Drivers Q3, Q4 and Q5, Power Fets Q6, Q7 and the control circuit.

Circuit Function

The microcontroller U56 with its built in oscillator controls all the timing for the Hyfrecator. The 2MHz frequency via amplifier U60 drives the counter producing 31,250 pulses per second at TP57, enabling U2 to turn on and off. Drivers Q3, Q4 and Q5 are turned on and off for a period of 0.2-6 micro seconds, which is determined by the Up/Down switches on the front panel or on the Switching Handle.

During the "ON" time, the drain of Q3 and Q5 are high, and Q4, Q6 and Q7 are switched on. Current through the output transformer primary increases linearly by $I=ET/L$. When Q6 and Q7 are switched off, the energy in T2 primary resonates with C21 producing a damped sine wave in the secondaries.

Section 3 – Circuit Description

Power Supply

CAUTION: The 115, 215, 230, or 245 volt AC mains is never turned off in this instrument. The power switch is in the low voltage power supply. A constant 5 volts is supplied to U56 to retain memory. (Units wired for 100 volts AC mains do not have memory, the power switch controls the 100 VAC mains.)

The power supply delivers three regulated voltages, -5, +5 and +15, and one unregulated high voltage, 55, at TP5. These voltages are generated from two secondary windings on transformer T1. Full wave bridges BR1 and BR2 supply the plus voltages. Doubler diodes CR1 and CR2 supply the voltage for the -5 volts.

Microcontroller

Eeprom-Based 8-bit Microcontroller, U56, with its built in oscillator controls the base frequency for timing. The oscillator with its ceramic resonator Y51 operates at 2MHz.

The microcontroller U56 has two controlled set levels. These levels can be referred to as the 15 watt low output and the 30 watt high or bipolar output. The last setting of these two levels is independently remembered and controlled by the microcontroller. When I/O port pin 18 is held low, the microcontroller counts Up. When I/O port pin 17 is held low the microcontroller counts Down.

In the 15 watt low terminal, the scale changes in increments of .2 from 0-5 and in increments of 1 from 5-15. In the 30 watt high or bipolar terminal, the scale changes in increments of 1 from 0-30.

The microcontroller U56 generates the two levels, data, clock and strobe signals necessary to operate a 8 stage shift/store register U58 and a 7-segment decoder driver U59.

One I/O port pin 2 held low disables all input I/O ports during activation of the output power.

Reference Voltage

The reference voltage is a digital signal from the microcontroller U56 driving U58 8-stage shift register. The digital signal drives U57 Digital Analog Convertor and U53 amplifier to generate the DC reference voltage of 2.50 for full scale. The voltage is controlled by the switches at the I/O ports Up/Down of the microcontroller.

LED Display

The two seven segment light-emitting displays are driven digitally from the data U59, 7-segment decoder driver.

Control Circuit

When pin 3 of J2 is at ground, or a low, current flows through R6, photo triac diode A1, illuminating LED DS51. This turns on the photo triac A1 turning on Q1, supplying the high voltage. A low at U51 12-bit binary counter enables the device, and pulses are generated for sound and the repetition rate. The repetition rate pulses of 31,250Hz trigger U1 D Flip-Flop to generate a positive pulse at pin 12 and a negative pulse at pin 13 approximately 1.75 microseconds in width.

A low at U54 pins 8 and 9 produces a low at U54 pin 10 and U56 microcontroller pin 2. This low disables the microcontroller U56 for the period the unit is delivering power and 30 milliseconds after U51 binary counter is reset.

A low at U55 pin 2 gates a 2000 Hz signal for the audio tone.

If pin 3 of J2 is low and a up or down switch is activated, U55 pins 12 and 13 will gate a 1000 Hz audio tone superimposed on the 2000 Hz. This represents a different tone than the activation switch for power output.

Comparator

The pulse width to control output power is generated by the comparator U2. U2 is gated on and off at a repetition rate of 31,250Hz. This repetition rate of 32 microseconds is generated by the 12 bit binary counter U51. Strobe pin 6 of U2 and timing capacitor C15 are gated on and off via U1 and Q2 by the pulses at TP8 and TP10. When Q2 is saturated, reducing the charge on C15 to zero, the strobe pin 6 is low. When the strobe pin 6 of U2 goes high, test point TP3 goes low. TP3 will go high again when the charge on C15 is greater than the reference voltage at pin 3, of U2. The larger the reference voltage setting between pins 2 and 3 of U2, the larger the negative pulse width at TP3.

Driver

The drain of Q3 and Q5 are out of phase with pin 7 of comparator U2. When TP3 is high, Q3 and Q5 are saturated, turning off Q4, Q6 and Q7. When TP3 is low, Q3 and Q5 are turned off, turning on Q4, charging the input capacity of Q6 and Q7.

Output

The power stage consists of two Power Mosfets, Q6 and Q7, operating as pure switches once the input capacity is charged sufficiently for drain current to flow. When Q3 and Q5 are turned off by the drive from U2, Q6 and Q7 switch on, and conduct high amperes of peak current, storing magnetic energy in the primary of T2. When Q6 and Q7 are turned off, the primary of T2 resonates with C21. The result is a damped sinusoid wave shape. The energy is coupled by secondary windings to generate output power. The damped wave shape varies with the output load. With average physiological loads, one high amplitude pulse exists with subsequent lower oscillating amplitudes.

Sound

A tone is generated when the Hyfrecator Plus is delivering power. The tone is generated by an audio transducer LS1, driven by one section of U1. The frequency of the tone is approximately 2000 Hz and is generated by a 12-bit binary counter U51. The audio level is adjustable with R25 to a level not less than 65db. A second tone is generated when the Hyfrecator Plus is delivering power and one of the Up/Down buttons is operated.

Section 4 – Service Information

Safety And Service Precautions

CAUTION: • For your safety, unplug the HYFRECATOR PLUS before you attempt to disassemble or service. When calibrating the HYFRECATOR PLUS with the power ON, please use extreme caution.

- Do not insert power cord connector into the wall socket unless the line voltage and frequency are as stated on the serial number plate.
- Ground circuit reliability can be achieved only when the Birtcher HYFRECATOR PLUS is connected to a properly grounded hospital grade wall receptacle.
- Do not operate the HYFRECATOR PLUS in the presence of flammable anesthetics. Doing so may cause injury to patient, staff, physician or damage to the unit.
- Federal law restricts operation of the HYFRECATOR PLUS to qualified physicians or other qualified practitioners.

Tools And Test Equipment

The model 7-797 HYFRECATOR PLUS requires only standard electronic tools for maintenance. The following is a list of suggested equipment for maintenance of your unit.

1. Digital Multimeter Beckman Tech 310
2. Electrosurgery Analyzer Dempsey 443
3. Leakage Meter Bio-Tek 150M
4. Oscilloscope Tektronic 5440

NOTE: Test equipment manufactured by a company other than specified may be substituted if comparable. Please call the Birtcher Medical Systems Service Department if you are unsure.

Section 5 – Suggestions For First Time Operation

Before using the HYFRECATOR PLUS clinically, we suggest the following experiment.

Hold a quarter-pound piece of room temperature beef or chicken in hand or place it on a table, and touch it with your hand to improve the path of electrical flow. Starting with a low power setting, experiment as follows:

- Desiccation: In the monoterminal without a dispersive plate mode, using an Electrolase Tip, touch the meat and turn on the current for one to five seconds. Use different intensities with the low and the high output terminals. Cut the meat open with a scalpel and view the depth of penetration. A mild blanching of the tissue is sufficient for most conditions.
- Fulguration: Using either the low or high output terminals, bring the electrode near, but not touching the meat (one to three mm). Use various settings and observe the different degrees of fulguration that can be produced. Short bursts of a spark alternated with short cooling periods are most acceptable to the patient. Continuous application of the spark creates heat that may become intolerable. Cut the meat open at the fulgurated spots to view the relatively shallow effect.
- Coagulation: If you have purchased the optional foot switch, non-switching handle and cord and dispersive patient plate or the forceps and footswitch, you may wish to experiment with the effects of monoterminal and bipolar coagulation. You will find that monoterminal coagulation produces very deep effects while bipolar coagulation produces relatively superficial effects.

A training tape covering basic dermatological procedures utilizing the HYFRECATOR PLUS is available from your Authorized Birtcher Medical Systems Distributor (product number 7-796-21).

Section 6 – Removal And Replacement Procedures

CAUTION: For your safety, please be sure that the HYFRECATOR PLUS is unplugged prior to performing any service.

NOTE: For all removal and replacement procedures, please refer to Drawing 16.

1. The front cover can be removed by removing the six Phillips head screws (item 18 of Main Housing Drawing 15 from the recesses on the back panel).
2. The Main Printed Circuit Board can be removed from the rear cover by removing four small Phillips head screws and four large Phillips screws from the corners of the transformer (item 9 and 12 of Main Housing Drawing 15).
3. The display board can be removed from the front cover by removing the four small Phillips head screws (item 9 of Main Housing Drawing 15).

Section 7 – Safety And Performance Checks

Safety Checks

Line Cord Continuity

1. Disconnect the power cord from the wall receptacle.
2. Connect an ohmmeter between the positive and the neutral terminal of the line cord for proper continuity.
3. If the line cord has been repaired or replaced, check to see that proper polarity has been maintained.

NOTE: Leakage tests should be conducted using a Bio-Tek 100M leakage meter, or comparable meter with similar characteristics capable of testing to AAMI specifications. Inappropriate meters can produce "ERRONEOUS LEAKAGE" readings. Leakage tests should be performed at a non-conductive work station.

WARNING: Use caution when conducting these tests. The meter must be suitably insulated and capable of withstanding the power line voltage.

Chassis Leakage

1. Push the HYFRECATOR PLUS side ON/STANDBY OFF switch to ON.
2. Connect the leakage meter in series with the line cord and line power receptacle.
3. Ensure that leakage current is less than 50 microamps.
4. Open ground line and ensure leakage current is less than 50 microamps.
5. Reverse line polarity and ensure that leakage current is less than 50 microamps.
6. Turn the HYFRECATOR PLUS ON/STANDBY OFF switch off. Repeat above leakage tests.

Performance Checks

1. Plug in the power cord, and switch the ON/STANDBY OFF switch to the ON position.
 - a. The LED display illuminates zero
 - b. Move Terminal Selector switch to the extreme left.
 - c. Push UP button for full scale reading.
 - d. The LED's should Display 30.
 - e. Move the Terminal selector switch to the center position.
 - f. The LED's should Display 15.
2. Attach Switching Handle and Cord Socket and Plug.
 - a. Press the DOWN button, and the display should decrease one digit at a time for approximately six counts and then decrease rapidly.
 - b. Press UP button, and the display should advance one digit at a time for approximately six counts and then advance rapidly.
 - c. Switch the ON/STANDBY OFF switch to the OFF position for ten seconds.

- d. Switch the ON/STANDBY OFF switch to the ON position and the LED display will display the last setting in item b above. (Not applicable for 7-797J)
- e. The active indicator green LED should illuminate and a tone should be audible each time the POWER ACTIVATION button is pressed.
- f. Pressing the POWER ACTIVATION button and a UP or DOWN button at the same time inhibits the UP/DOWN function, and a distinct tone is audible.

3. Test the power output in one of three ways.

- a. Follow the suggestions for first time operation, found on pages 9 and 10.
- b. Connect the electrosurgery analyzer to bipolar terminals, and check the power output correlation to the LED display.
- c. Connect a 25 Watt light bulb across the bipolar terminals, and the light bulb should illuminate at approximately three-quarters intensity.

Section 8 – Problem-Solving

NOTE: Before following any of the troubleshooting remedies outlined below, please read and follow the Removal and Replacement Procedures on page 10 and Block Diagram Figure 1.

Troubleshooting

Fault/Condition	Probable Cause	Remedy
Front Panel inoperative	Fuses F1 and F2 are blown or missing.	Replace the blown fuse(s) with the appropriate replacement; see drawing 9,10,11,15
	Power switch is faulty.	Disconnect line cord from power mains; turn power switch to the on position; check continuity of switch and primary circuit; replace defective component
	Transformer T1 is defective.	Connect line cord to power mains; turn power switch to on position; check for the following AC voltages at T1: 220 at pins 10-12, 45 at pins 7-9.
	No low voltage.	Check for DC voltage at the following

No output power, however, there is defective sound and DS51 illuminates.	Q6 and Q7.	TP: 55 at TP5, 15 at TP11, -5 at TP12, 5 at TP13, minus probe of volt meter at TP7.
	No 55 DC volts at TP5.	Check Q1, U3, BR2 C8, for proper operation. Replace defective component.
	U1, U2, Q2, Q3, Q4 or Q5 is defective.	Check for correct voltage and wave forms per block diagram and schematic. Replace defective component.
LED Display does not light.	U56, 59, 54, 55, DP51, 52, VR51, 3 and 1.	Check for +5 DC Volts at TP51; -5 DC Volts at TP53; +5 DC Volts at TP9, 11. Replace defective components.
Display reads 0, will not go up in number with the UP/DOWN Switches.	U56, 59, 54, VR3, DP51 or 52.	Check for 5 DC Volts at TP51. Check for 5 DC Volts at pin 2 of U56. Check wave forms. Replace defective components.
No sound when unit activated.	U55, 1, LS1 or R25.	Check wave form at TP55 and pin 1 U1. Replace defective component.

Section 9 – Calibration

WARNING: The electrical voltages present in the HYFRECATOR PLUS are capable of causing death or injury. Please be sure to use extreme caution when servicing this equipment with the power on.

For optimum performance, you should calibrate your HYFRECATOR PLUS following the replacement of any component on the display PCB or power supply PCB, or following the replacement of either PCB itself.

1. Press ON/STANDBY OFF SWITCH to the ON position.
2. LED display should display zero.

3. Set TERMINAL SELECTOR SWITCH to the extreme left position.
4. Activate UP button for a display of 30.
5. Adjust R68 for 2.5 volts \pm 1 volt at TP54.
6. Activate DOWN button for a display of 20.
7. At a display of 20, activate the Switching Handle, and adjust R14 for 20 Watts output into the Electrosurgery Analyzer, 500 ohm load.
8. At a display of 5, activate the Switching Handle, and adjust R53 for 5 Watts output into the Electrosurgery Analyzer, 500 ohm load.
9. Repeat steps 7 and 8 as necessary to achieve proper calibration.
10. Check power output at zero display for zero output power.
11. Adjust R25 for desired sound level.

Characteristics

1. Display Digital, no flicker.
2. Up/Down function.
 - a. Advances display in .02 increment, 0-5 range, low terminal.
 - b. Advances display in 1 increment, 5-15 range, low terminal.
 - c. Advances display in 1 increment, high and Bi-polar terminal.
 - d. Advances display from zero to full scale in 10 seconds.
3. Power Output.
 - a. Zero at Zero display.
 - b. 15 watts full scale, 500 ohm load, low terminal.
 - c. 30 watts full scale, 500 ohm load, high terminal and Bi-polar terminal
4. Activation of Handswitch or Footswitch.
 - a. Enables 2kHz audible tone.
 - b. Disables Up/Down function.
 - c. Enables Amber LED display.
 - d. Enables power output.
5. On/Standby Off.
 - a. Turns off display.
 - b. Holds Micro-controller in memory.
 - c. Disables Up/Down functions.
 - d. Disables power output.
6. UP/DOWN, Handswitch or Footswitch activated at same time.
 - a. Enables 1kHz and 2kHz audible tone mixed..
 - b. Disables power output.

Section 10 – Maintenance

The HYFRECATOR PLUS requires little maintenance. To keep the instrument performing at its best, however, external cleaning should be performed on a regular basis.

NOTE: All internal service should be performed by qualified maintenance personnel only.

External Cleaning

To clean the external case of the HYFRECATOR PLUS and the up/down switching handle and cord:

- Moisten a lint-free cloth with a mixture of mild soap and water.
- Clean all external surfaces with this solution.
- Dry all surfaces thoroughly using a clean, lint-free cloth.

Soap-based solutions – rather than harsh chemicals – are recommended cleaning agents for the HYFRECATOR PLUS. Evaporative solutions are preferred so as to limit exposure of internal electrical components. Material characteristics of the unit do not allow for gas, steam or cold sterilization techniques.

Steam Sterilization of Accessories

NOTE: Do not autoclave the 7-796-5 power up/down switching handle and cord. If procedures require sterility, use Ethylene Oxide at <140°F.

[If a footswitch is utilized, a sterile disposable non-switching pencil and a reusable adapter can be utilized (product number 137657 for the pencil and 670-3 for the adapter). An autoclavable reusable non-switching pencil is also available (product number 7-796-6), which also requires a footswitch (product number 7-796-4).]

To steam sterilize accessories and electrodes:

- Place accessories in autoclavable packaging or wrap with a cloth.
- Autoclave at 121°C (250°F) ± 3°C for 15 minutes minimum/20 minutes maximum.
- Remove accessories from the autoclave and allow to cool for 30 minutes minimum.

NOTE: It is not advisable to cold sterilize surgical electrodes due to potential corrosion.

Section 11 – Warranty

As manufacturer of the Birtcher Medical Systems HYFRECATOR PLUS 7-797 and other high quality medical equipment, Birtcher Medical Systems warrants all of its products to be free from defects in material and workmanship under normal operation and use. The warranty period for the Birtcher Medical Systems HYFRECATOR PLUS is twelve (12) months to the product's original owner.

NOTE: The warranty card must be returned by the original owner to Birtcher Medical Systems within ten (10) days of receipt of the invoice.

A ninety (90) day warranty is provided for standard and optional accessories. The ninety (90) day warranty includes the 7-796-5 power up/down switching handle and cord. There is no warranty on disposable, single-use items.

The warranty is limited to the repair or replacement (at the manufacturer's discretion) of any HYFRECATOR PLUS (or part thereof) that is returned to the manufacturer within the specified warranty period and which, after examination, is found to be defective.

Transportation of the HYFRECATOR PLUS must be prepaid by the sender. The unit will be returned pre-paid to the owner by the same manner of transportation used in shipping the product to the manufacturer.

The warranty does not apply to any product, or integral part thereof, that has been altered or serviced by anyone other than the manufacturer. Nor does it apply toward any product that has been damaged as a result of accident, abuse, misuse or negligence on the part of the user.

Section 12 – Repair Return Policy

HYFRECATOR PLUS units and any standard or optional accessories should not be returned to the manufacturer for warranty or non-warranty repair without prior authorization. A "Return Goods Authorization" (RGA) number will be issued by Birtcher Medical Systems' repair department upon request. This number must be prominently written in the upper left hand corner of the shipping container. To receive an RGA number, please call (800) 888-1771 or (714) 753-9400.

NOTE: Any merchandise returned to Birtcher Medical Systems without a Return Goods Authorization number will not be accepted by the receiving department and will be returned to the sender.

The Birtcher Medical Systems Warranty and Return Policy for the HYFRECATOR PLUS 7-797 supersedes all other warranties either expressed or implied and shall be governed and executed under the laws for the state of California, U.S.A.

Section 13 – Specifications

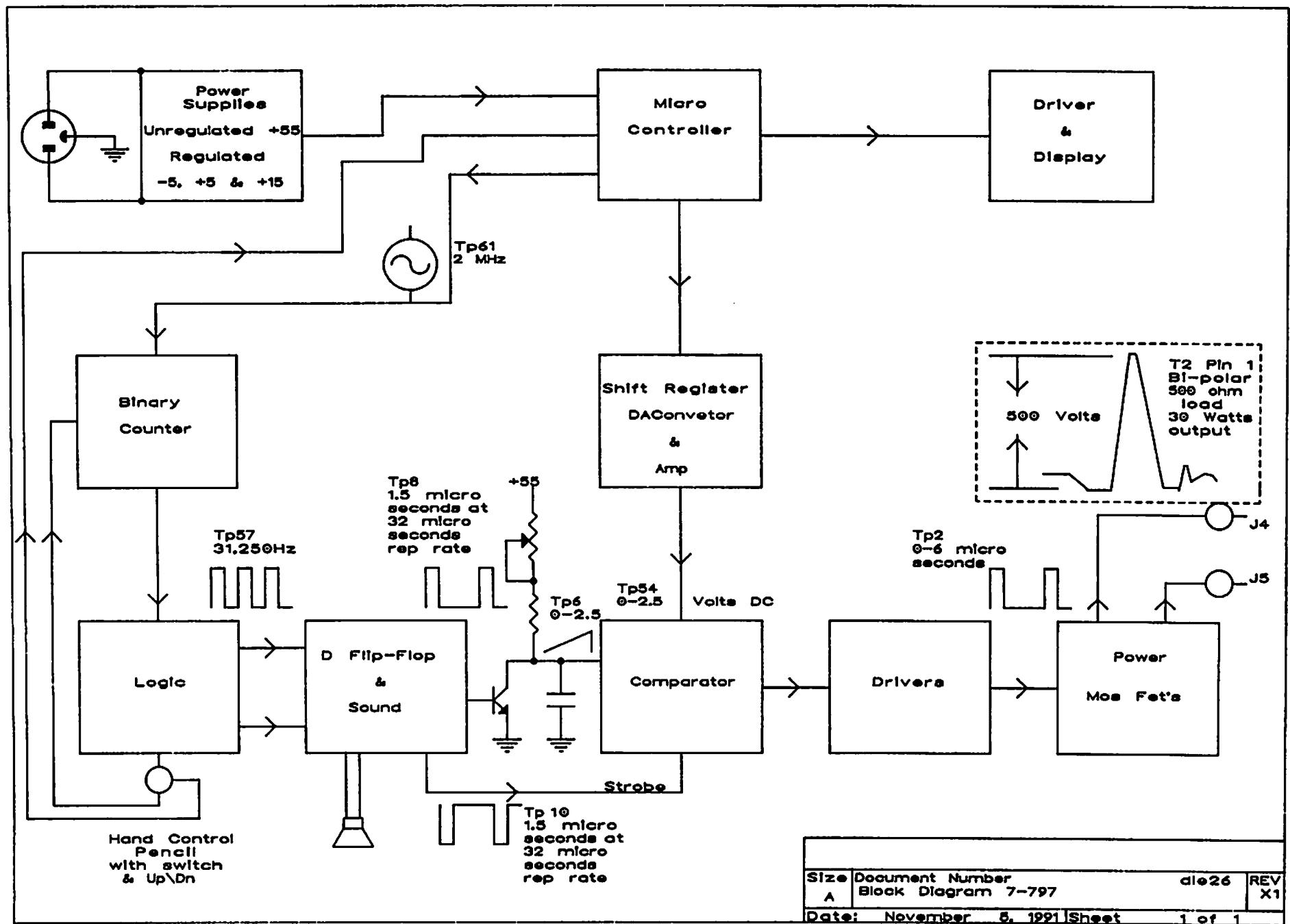
PARAMETER	CHARACTERISTICS
Environmental Conditions for Transport & Storage	
Temperature Range	-20°C to 60°C
Humidity	0% to 97%
Primary Power Requirements	
Model 7-797	120V 10% 50/60 Hz, 1 Phase;
HYFRECATOR PLUS	100V 10% 50/60 Hz, 1 Phase; 230V 10% 50/60 Hz, 1 Phase.
Input Current	120 V-900 Millamps max 100V-1000 Millamps max 230V-500 Millamps max
Dimension and Weight	
Depth:	4 inches (102 mm)
Width:	8.75 inches (222 mm)
Height:	7.5 inches (190 mm)
Weight:	6 pounds (2.7 kg)
Functional Characteristics	
Output Power	
Maximum Power:	36 Watts (500 ohm load)
Bipolar:	30 ± 6 Watts (500 ohm load)
High:	30 ± 6 Watts (1000 ohm load)
Low:	15 ± 2-6 Watts (500 ohm load)
Open Circuit Voltage	
Bipolar:	3000 Vpp max.
High:	8000 Vp, 10,000 Vpp max.
Low:	4000 Vpp max.
Mode of Operation	Intermittent
Leakage:	60Hz: 50 microamps max., with third wire of line cord open.
Frequency:	500 KHz at 31.25 kHz rate.
Output Wave Shape:	Damped sinusoidal.
Output Regulation:	± 30% at 30 Watts (500 ohm load) for a ± 10% line voltage.
Duty Cycle:	10 s on, 30 s off
Audio:	1kHz and 2kHz, 65 db min.
Display Reading Speed 0-30:	10 seconds

Accuracy	1% at any setting
Low Range	
0-5 range:	.2 watt increments
5-15 range:	1 watt increments
Bipolar & High Terminal	1 watt increments
Approvals:	CSA, Standard C22.2, No. 125, IEC 601-1, IEC 601-2-2 Standards UL544
Risk Class:	High, Low: 2G Bipolar: 2
Protection:	CLASS I Type BF with Defibrillator Protection

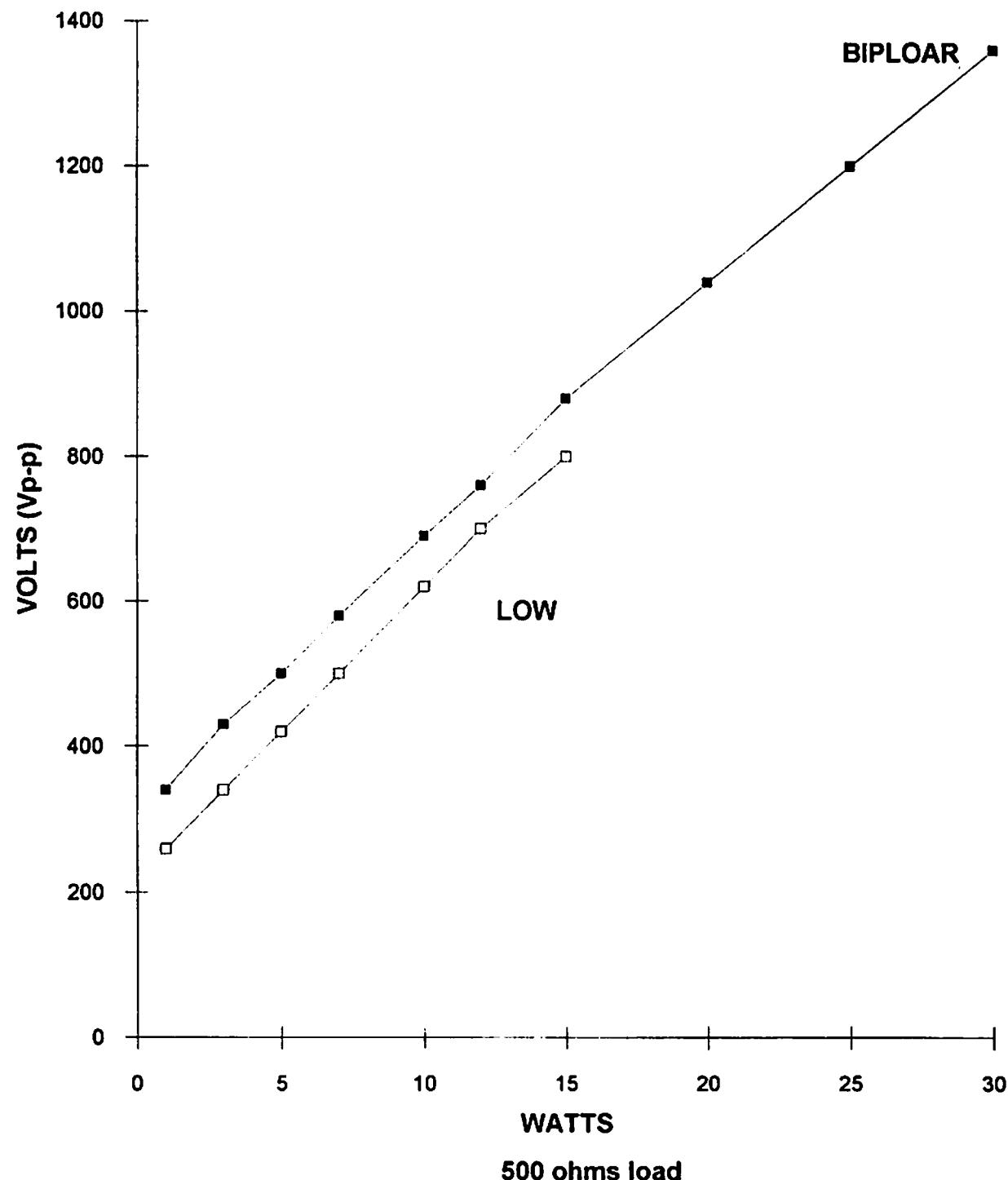
Section 14 – Drawings And Schematics

Item	Description	Page
Figure 1, 1a	Control Functions.	3, 5
Figure 2	Block Diagram.	1a
Drawing 1	Power Output - Voltage Bipolar—Low.	2a
Drawing 2	Power Output-Voltage.- High.	3a
Drawing 3	Output Power vs Display Setting Bipolar, 500 ohms Load.	4a
Drawing 4	Output Power vs Display Setting High, 1000 ohms Load.	5a
Drawing 5	Output Power vs Display Setting Low, 500 ohms Load.	6a
Drawing 6	High Load Curve.	7a
Drawing 7	Low Load Curve.	8a
Drawing 8	Bipolar Load Curve.	9a
Schematic	Motherboard.	10a, 11a
Schematic	Display.	12a
Drawing 9	Motherboard, 115, 230 Volt PCB Assembly.	13a
Drawing 10	Motherboard, Parts List.	14a
Drawing 11	Motherboard, 100 Volt PCB, Assembly.	15a
Drawing 12	Display PCB Assembly.	16a
Drawing 13	Display Parts List.	17a
Drawing 14	Display PCB Assembly.	18a
Drawing 15	Main Housing Assembly.	19a
Drawing 16	Pencil Assembly.	20a

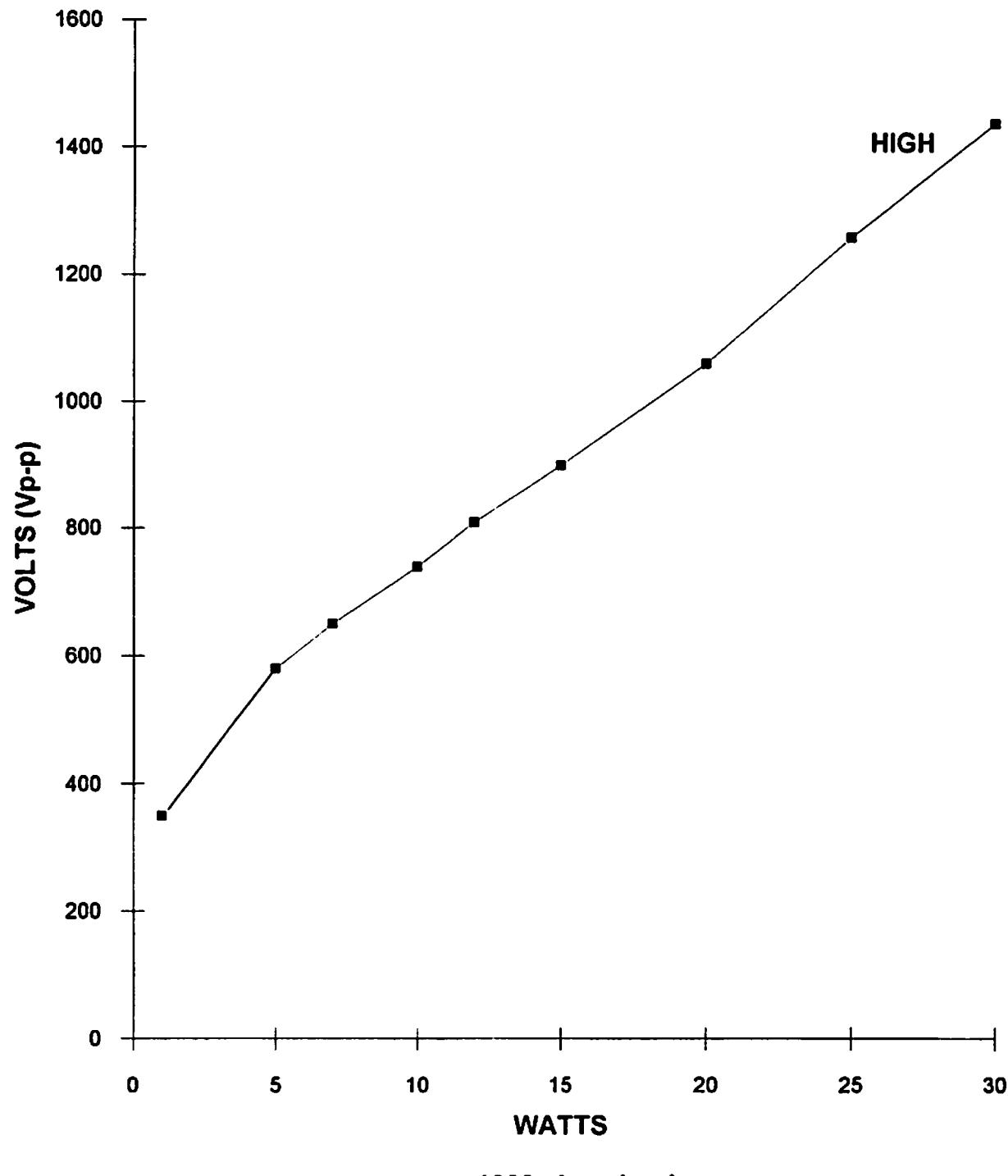
Figure 2



POWER OUTPUT - VOLTAGE

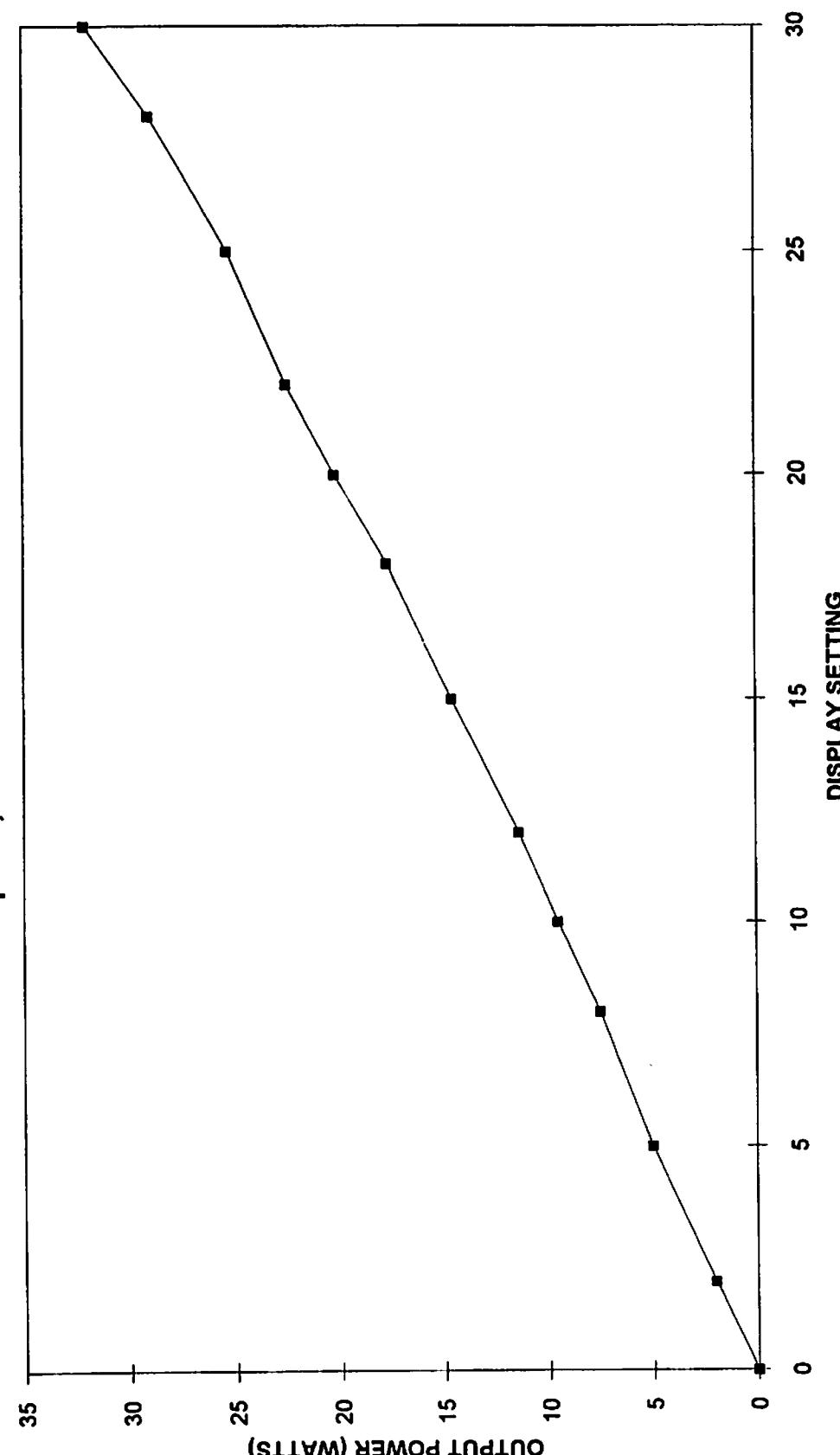


POWER OUTPUT - VOLTAGE



Output Power vs Display Setting

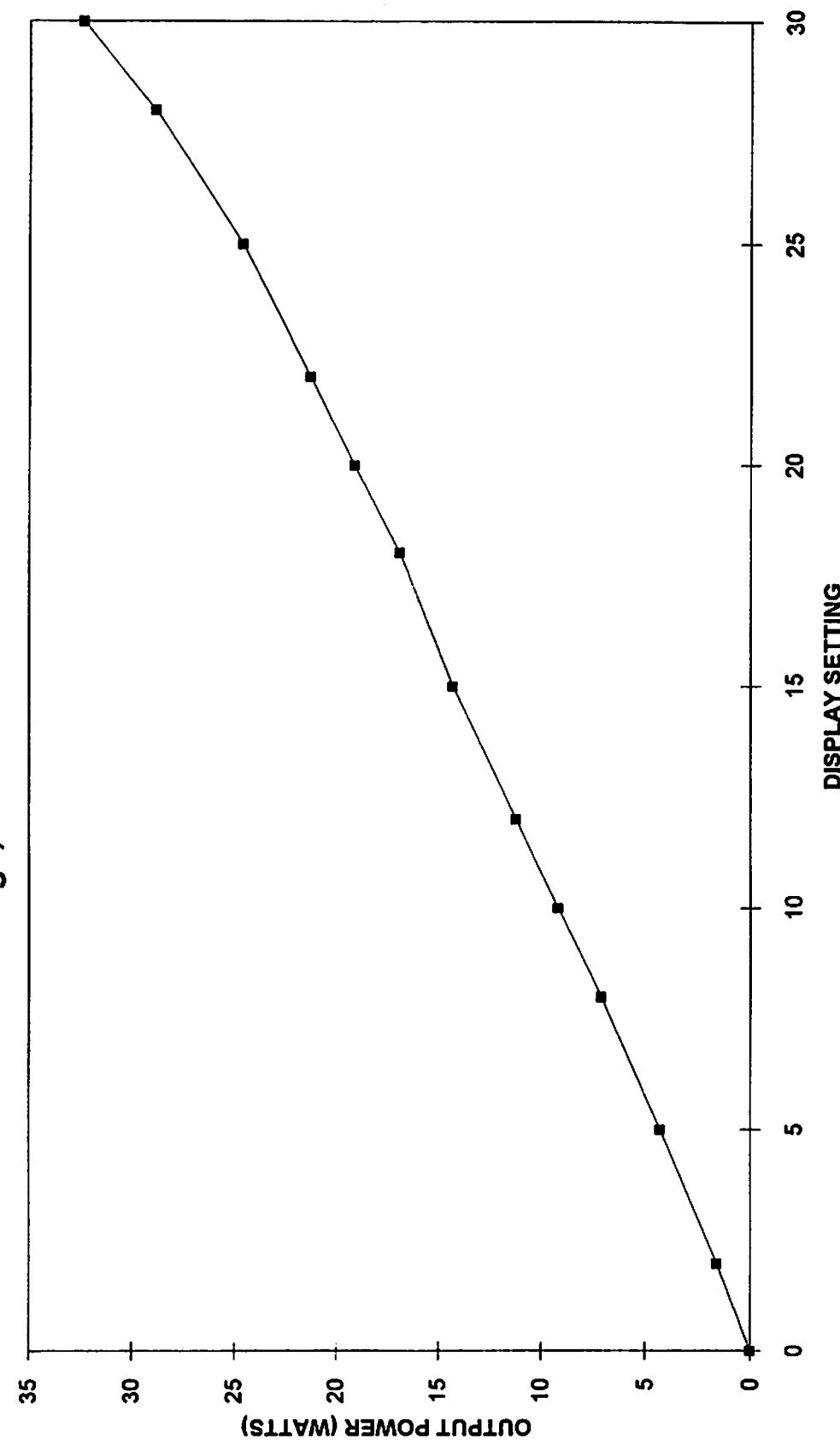
Bipolar, 500 ohms Load



Accuracy: $\pm 20\%$ of display setting or
 ± 1.5 watts into 500 ohms (whichever is greater)

Output Power vs Display Setting

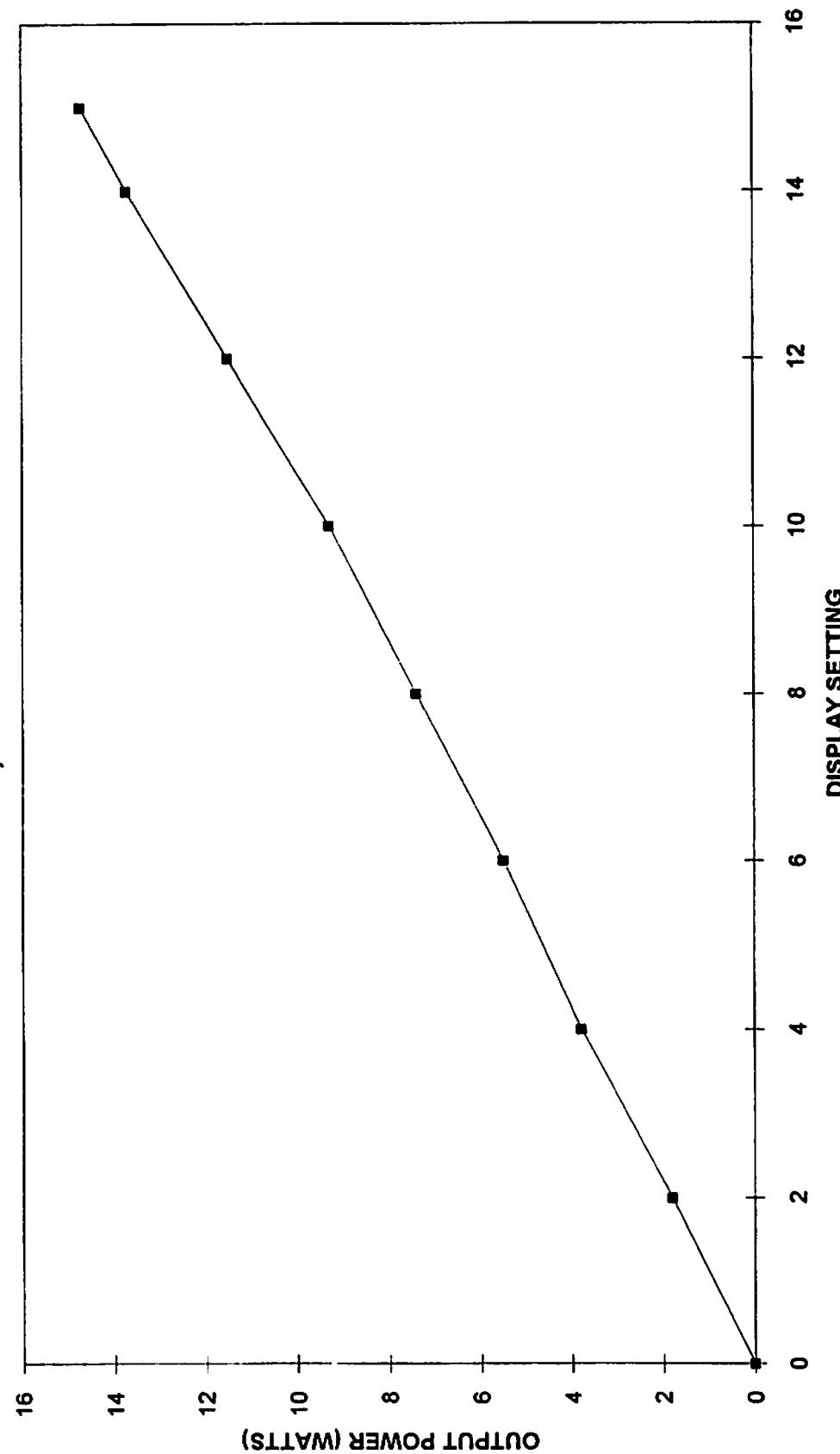
High, 1000 ohms Load



Accuracy: $\pm 20\%$ of display setting or
 ± 1.5 watts into 500 ohms (whichever is greater)

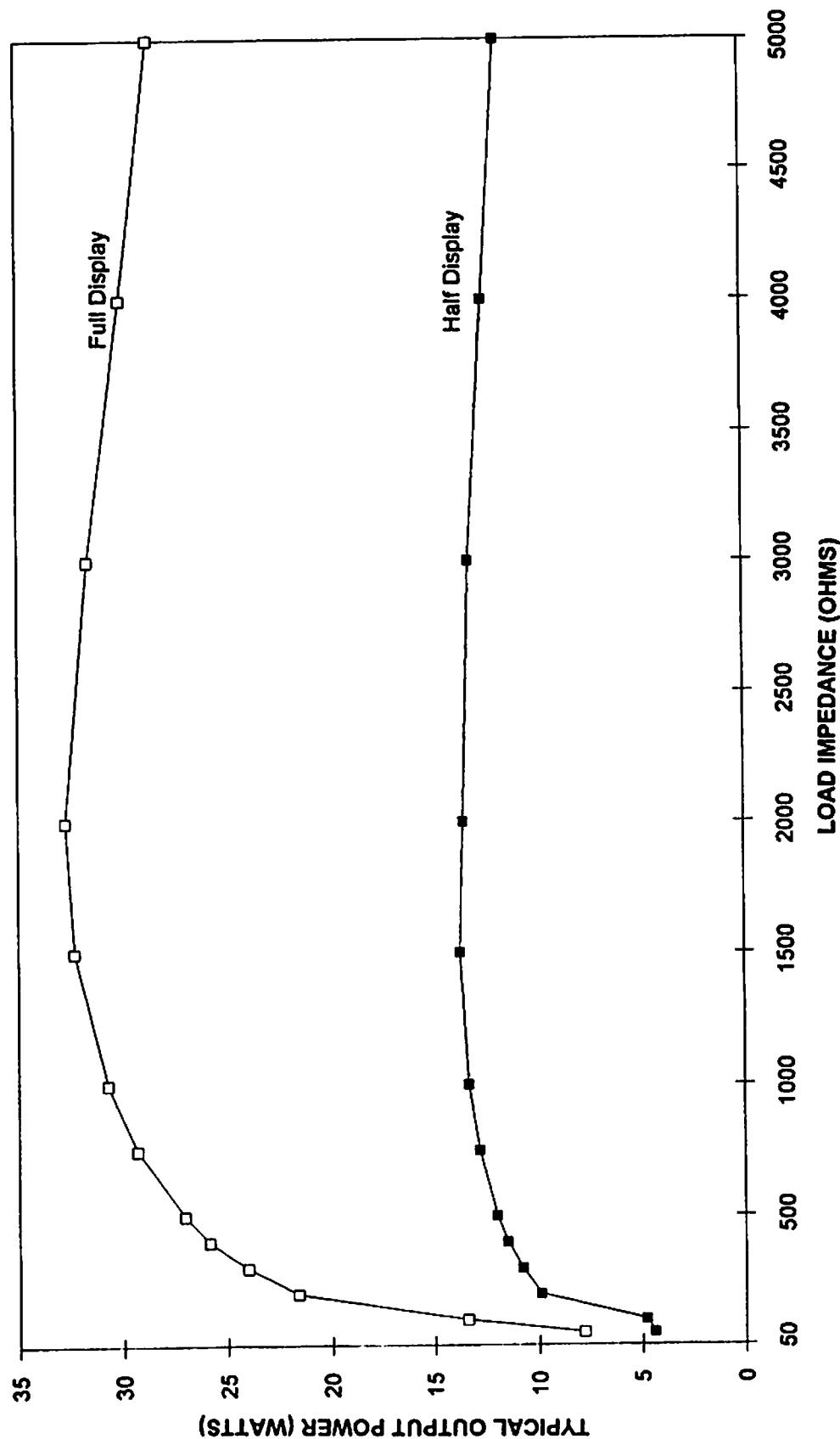
Output Power vs Display Setting

Low, 500 ohms Load

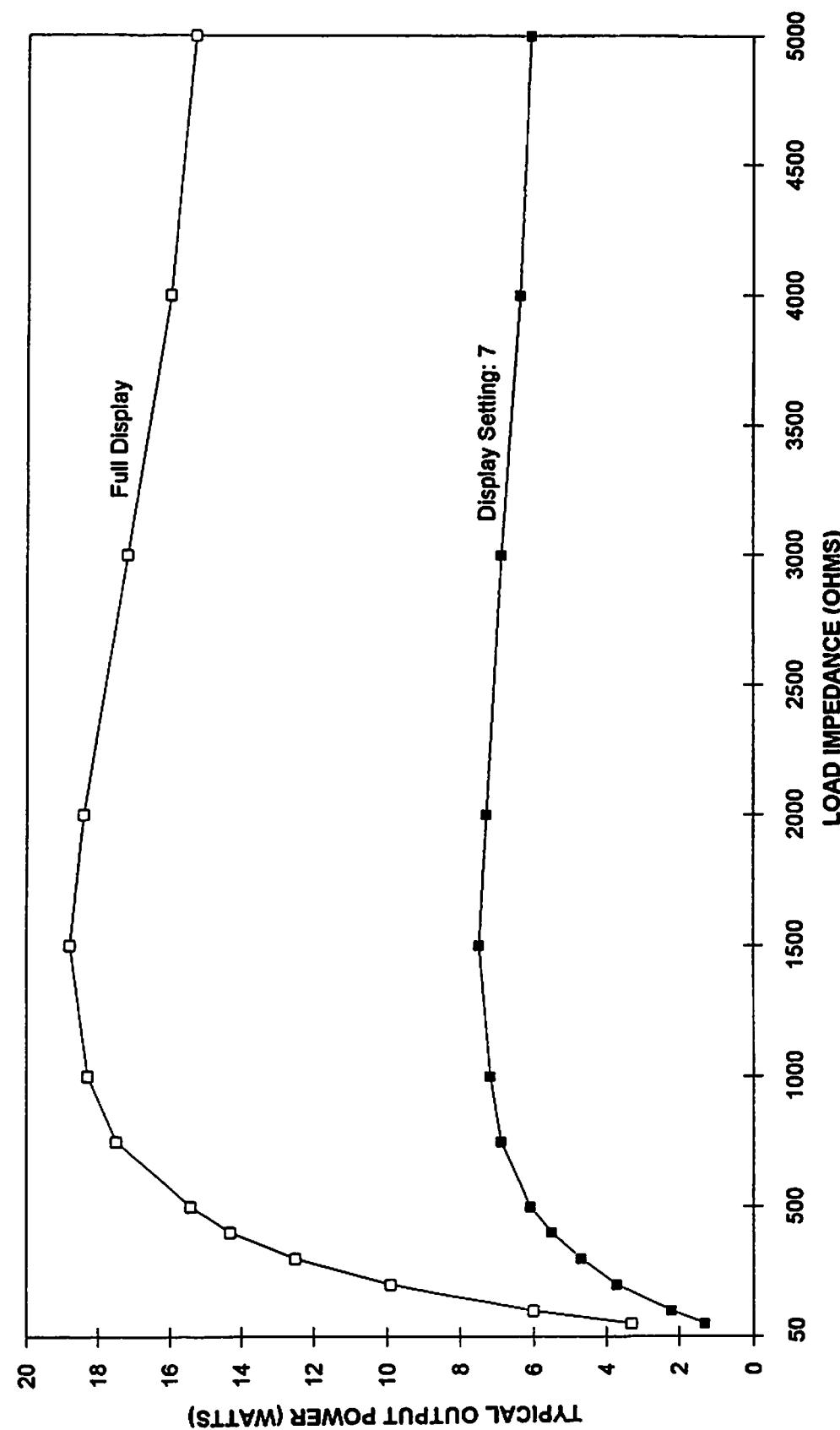


Accuracy: $\pm 20\%$ of display setting or
 ± 1.5 watts into 500 ohms (whichever is greater)

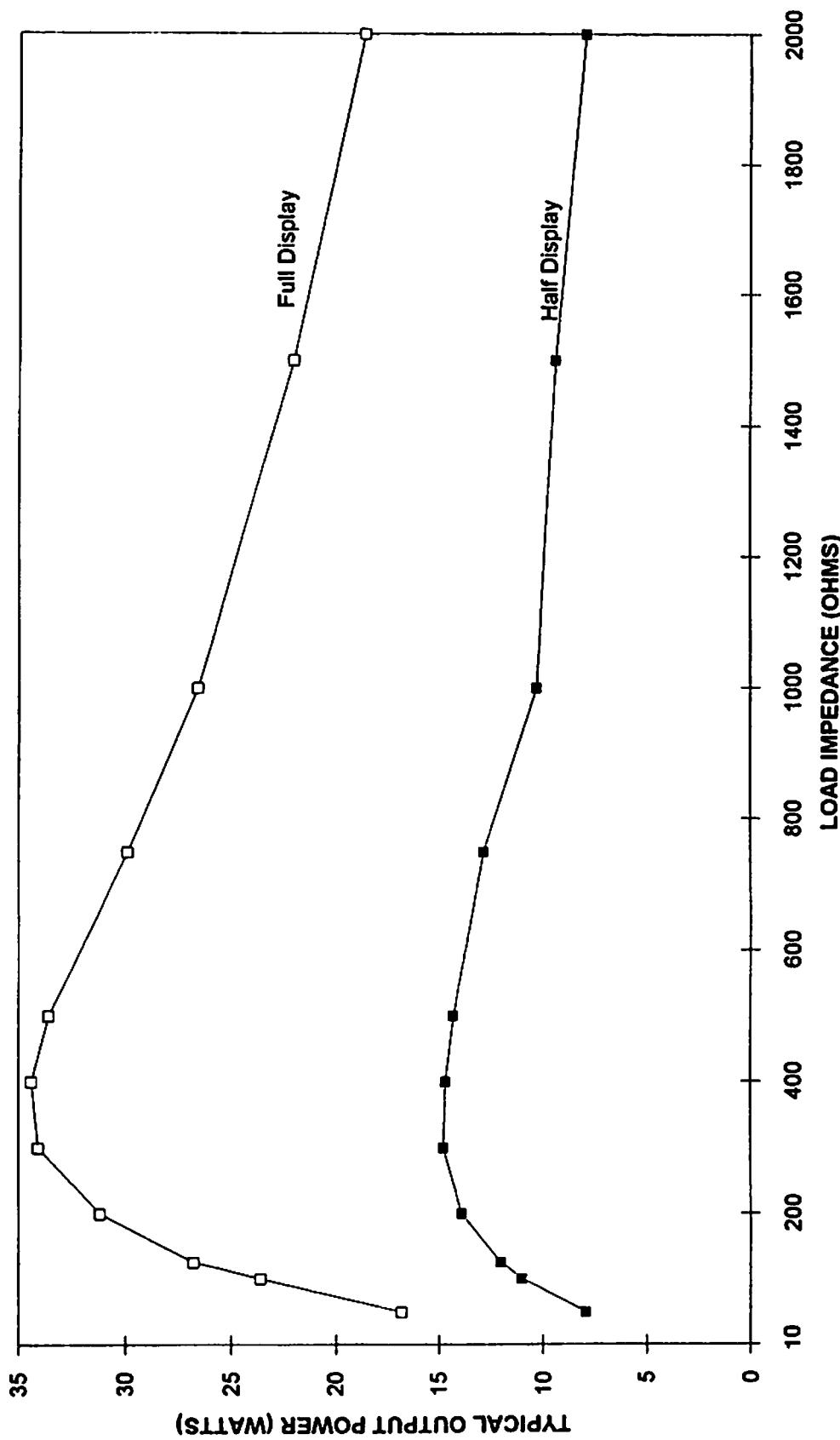
High Load Curve

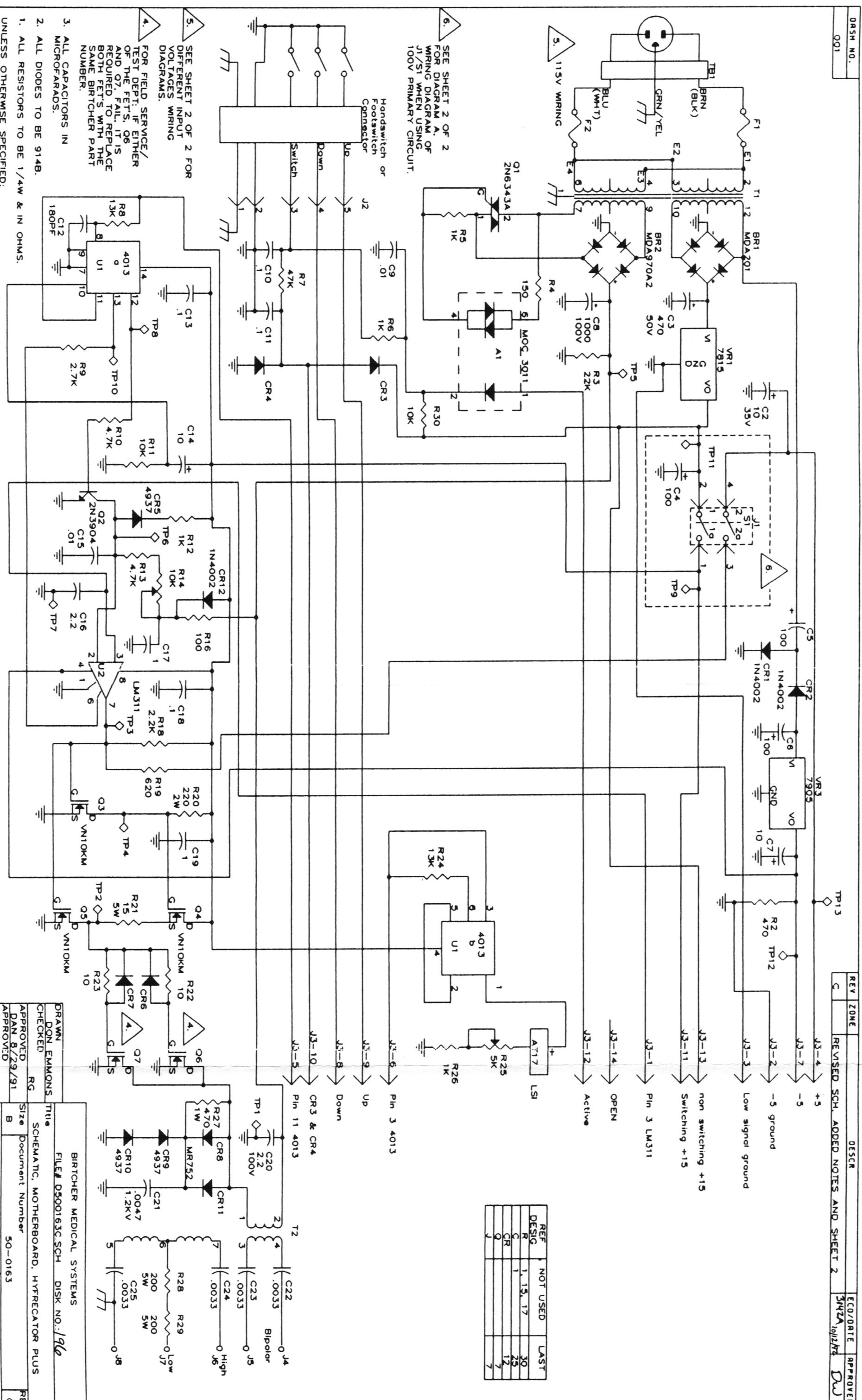


Low Load Curve



Bipolar Load Curve





MODEL 7-797-J (JAPAN)

130 Valt Werner

MODEL 7-797-A (EXPORT-215V)

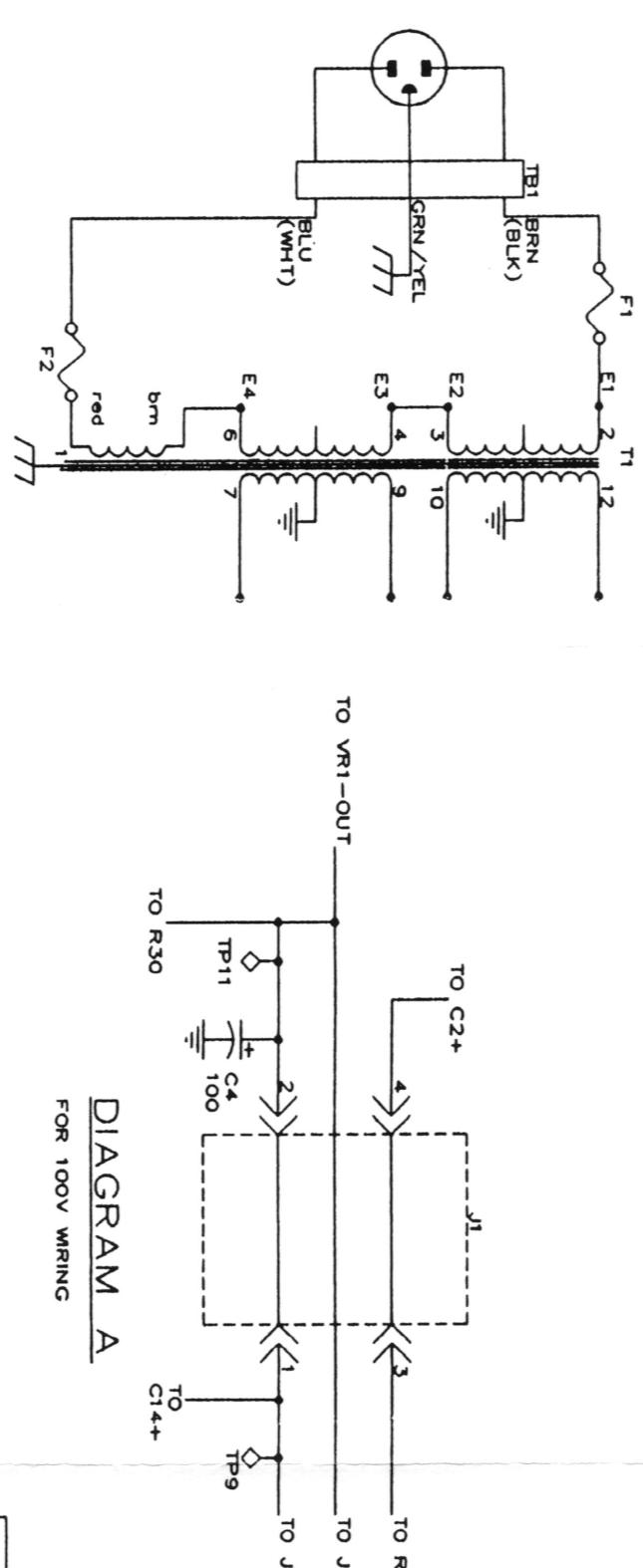
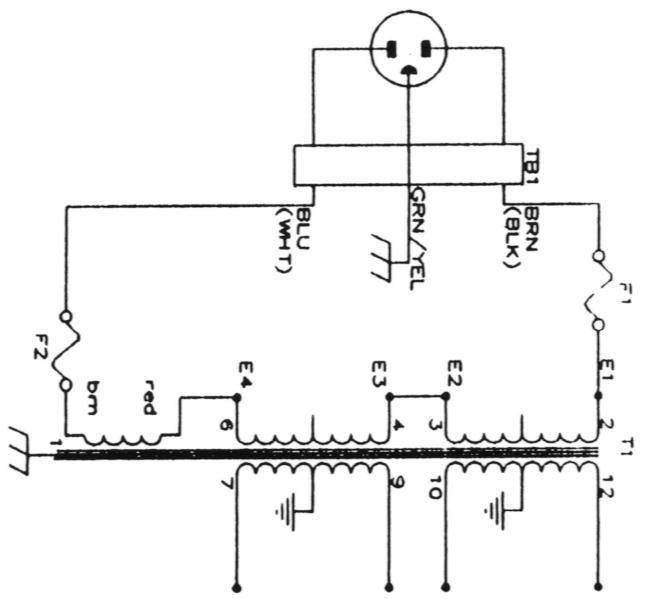
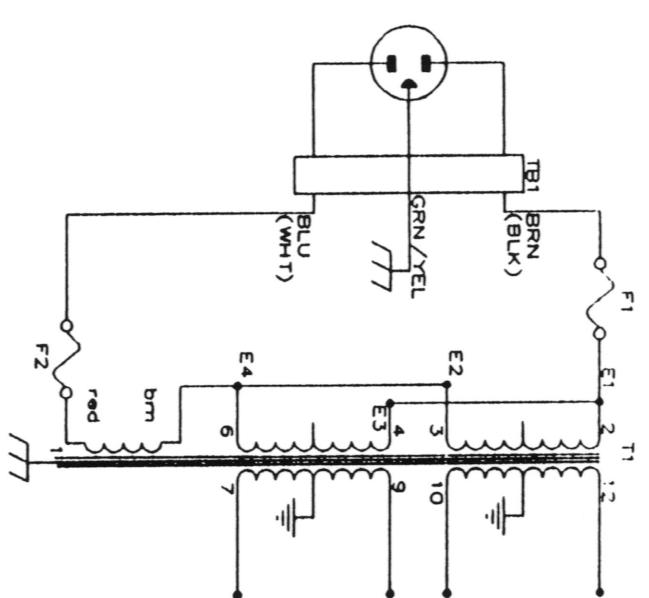
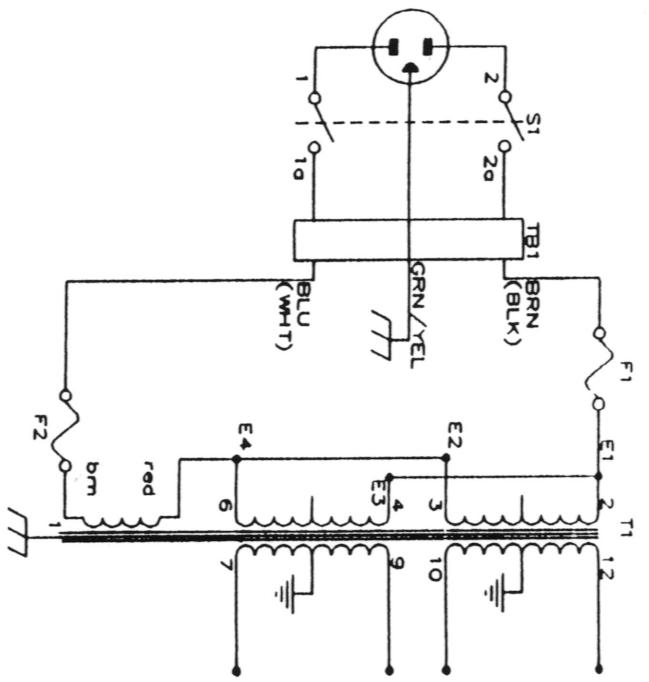
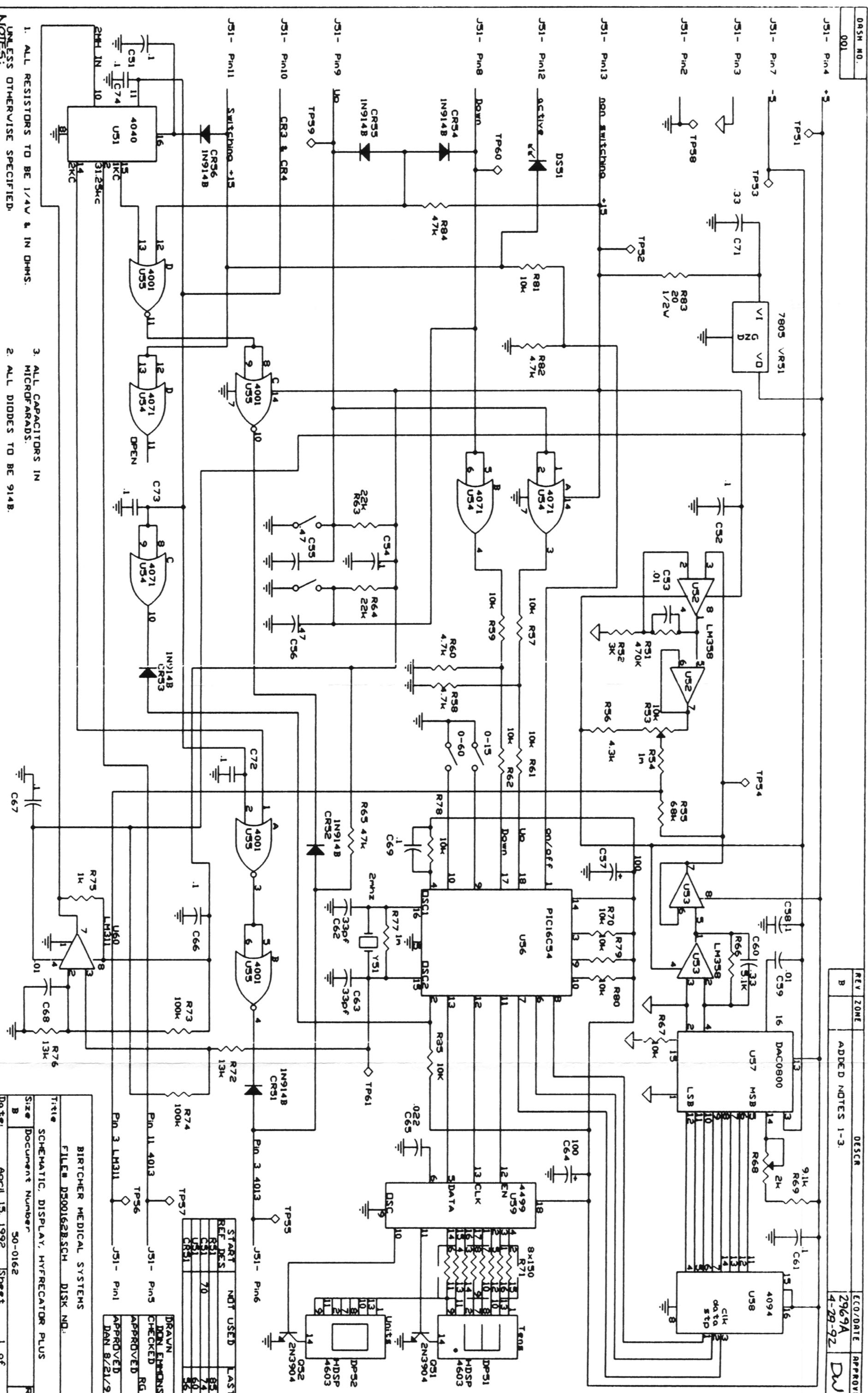


DIAGRAM A

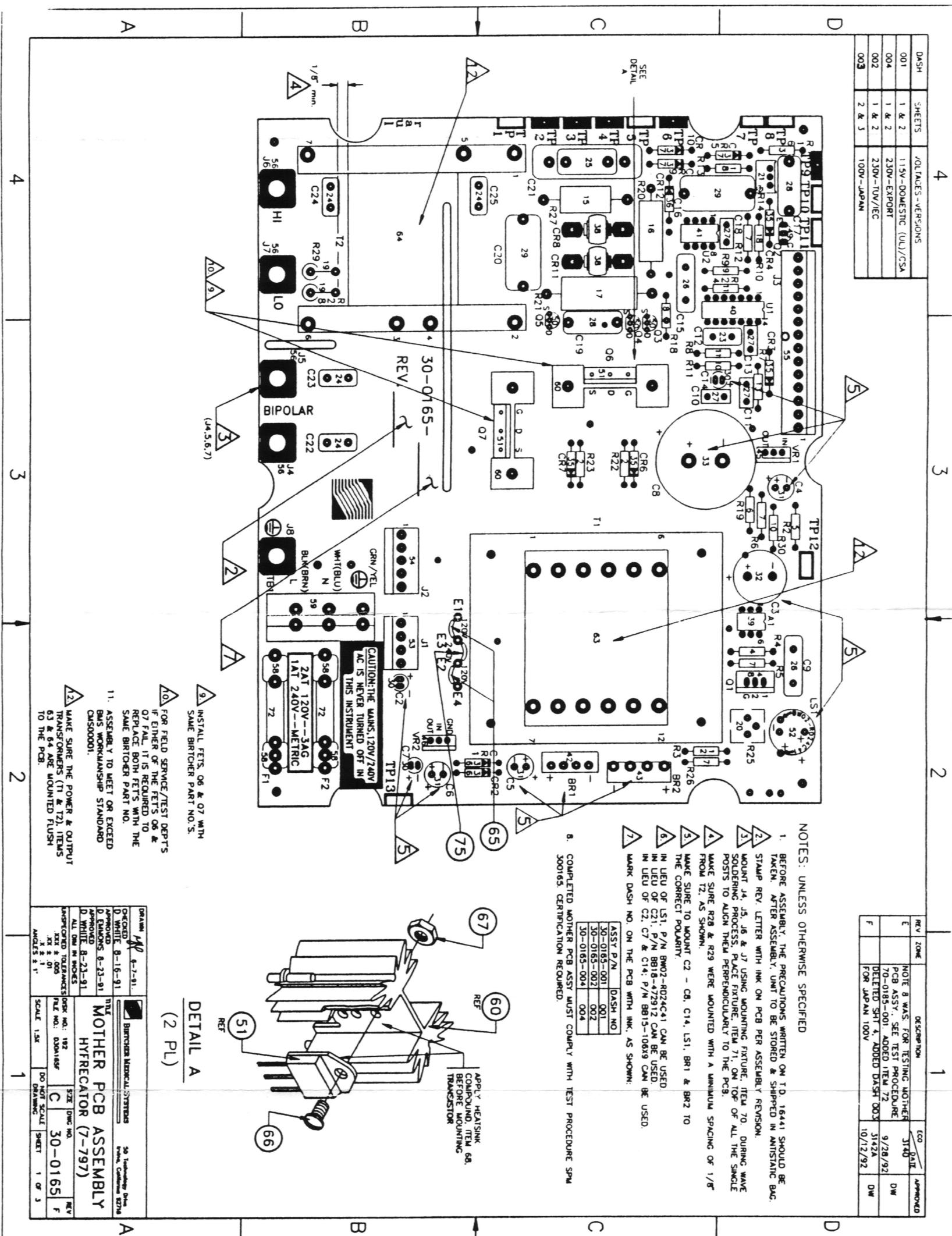
BIRTCHE MEDICAL SYSTEMS			
Title			
SCHEMATIC, MOTHERBOARD, HYFRECAATOR PLUS			
Size	Document Number	REV	
B	50-0163	C	
Date: September 29, 1992		Sheet	2 of



1. ALL RESISTORS TO BE 1/4W & IN OHMS.
UNLESS OTHERWISE SPECIFIED.
NOTES:

2. ALL DIODES TO BE 914BB
MICROFARADS.

Size B	Document Number 50-0162
Date: April 15, 1992	Sheet 1 of



ITEM/	REF. DESIGNATOR	SEE SHEET 1 OR 2	ECO DATE	APPROVED
1				

ITEM/	PART NUMBER	DESCRIPTION	REF. DESIGNATOR
1	06-0165-001	P.C. BOARD REV "B"	
2	01-0166-100	RESISTOR, 10Ω 1/4W 5% CARBON	R22.23
3	01-0166-101	RESISTOR, 100Ω 1/4W 5% CARBON	R16
4	01-0166-151	RESISTOR, 150Ω 1/4W 5% CARBON	R4
5	01-0166-471	RESISTOR, 470Ω 1/4W 5% CARBON	R2
6	01-0166-621	RESISTOR, 620Ω 1/4W 5% CARBON	R19
7	01-0166-192	RESISTOR, 1KΩ 1/4W 5% CARBON	R5.6.12.26
8	01-0166-222	RESISTOR, 2.2KΩ 1/4W 5% CARBON	R18
9	01-0166-272	RESISTOR, 2.7KΩ 1/4W 5% CARBON	R9
10	01-0166-103	RESISTOR, 10KΩ 1/4W 5% CARBON	R11.30
11	01-0166-133	RESISTOR, 13KΩ 1/4W 5% CARBON	R8.24
12	01-0166-223	RESISTOR, 22KΩ 1/4W 5% CARBON	R3
13	01-0166-473	RESISTOR, 47KΩ 1/4W 5% CARBON	R7
14			
15	BL14-471J	RESISTOR, 470Ω 1W 5% CARBON	R27
16	BL15-221J	RESISTOR, 220Ω 2W 5% CARBON	R20
17	01-0654-130	RESISTOR, 15Ω 5W 10% CARBON	R21
18	01-0654-472	RESISTOR, 47KΩ 1/4W 5% CARBON	R10.13
19	BL24-201J	RESISTOR, 200Ω 5W 5% CARBON	R28.29
20	BL17-50216-00	POTENTIOMETER, 5K 1T	R25
21	BL18-103W	POTENTIOMETER, 10K 25T	R14
22			
23	01-0655-181	CAPACITOR, 180 pF 500V DIPPED MICA	C12
24	8821-1-332J	CAPACITOR, 0033 μF 3KV CERAMIC DISC	C22.23.24.25
25	8821-472M	CAPACITOR, 0047 μF 1KV CERAMIC DISC	C21
26	8816-1039	CAPACITOR, 01 μF 100V POLYESTER	C9.15
27	8819-104K	CAPACITOR, 1 μF 63V MULTILAYER FILM	C10.11.13.18
28	8822-105K	CAPACITOR, 1 μF 100V METALIZED FILM	C17.19
29	8827-225K	CAPACITOR, 2.2 μF 100V METALIZED FILM	C16.20
30	8823-106M	CAPACITOR, 10 μF 35V ALUMINUM ELECTROLYTIC	C2.7.14
31	8822-107M	CAPACITOR, 100 μF 35V ALUMINUM ELECTROLYTIC	C4.5.6
32	8823-477M50	CAPACITOR, 470 μF 50V ALUMINUM ELECTROLYTIC	C3
33	8823-108M	CAPACITOR, 1000 μF 100V ALUMINUM ELECTROLYTIC	C8
34			
35	BL02-914B	DIODE IN914B	CR3.4.6.7
36	BL02-4002	DIODE IN4002	CR1.2.12
37	BL02-4937	DIODE IN4937	CR5.9.10
38	BL02-752	DIODE MR752	CR6.11
39	BL14-3011	I.C. MOC3011 6L	A1
40	BL15-4013B	I.C. 4013 14L (01020000)	U1
41	BL10-311N	I.C. LM311N 6L	U2
42	BL02-MDA201	BRIDGE RECTIFIER MDA201	BR1
43	BL02-MDA97042	BRIDGE RECTIFIER MDA97042	BR2
44	BL16-7815C	VOLTAGE REGULATOR +15V 7815C	VR1
45	BL16-7905CT	VOLTAGE REGULATOR -5V 7905CT	VR2
46	BL16-7905CT	VOLTAGE REGULATOR -5V 7905CT	
47			
48	BL06-6343A	TRANSISTOR 2N6343A	01
49	BL06-3904	TRANSISTOR 2N3904	02
50	N5326-0010	TRANSISTOR VNT0K	03.4.5
51	01-0861-001	TRANSISTOR FET	06.7
52	BN02-AT-17	BUZZER AT-17	L51
53	SEE TAB	CONNECTOR 156 CENTER 4 PIN	J1
54	BL005-0098	CONNECTOR 156 CENTER 5 PIN	J2
55	02-0390-014	CONNECTOR 156 CENTER 14 PIN	J3
56	24465-29	POST, SINGLE	J4.5.6.7
57	SEE TAB	for F1 & F2	
58	FUSE CLIP		
59	DE02-0021	TERMINAL BLOCK	TB1

ITEM/	PART NUMBER	DESCRIPTION	REF. DESIGNATOR
60	04-0440-002	HEAT SINK	FOR 06 & 07
61			
62			
63	1	SEE TAB	
64	1	3A37-7	
65	1	SEE TAB	
66	2	SCREW #4-40 X 3/8" LONG PAN HEAD	FOR E1/E3 & E2/E4
67	2	DIN2-0020	FOR 06 & 07
68	A/R J003-0004	COMPOUND, HEATSINK	FOR 06 & 07
69			
70	REF 14083	Fixture to mount J4.5.8 & 7	
71	REF 14085	Fixture for J4.5.8 & 7	
72	2	SEE TAB	F1 & F2
73	1.25	SEE TAB	MRE INSULATED
74			
75	5	SEE TAB	JUMPER WIRE

TABULATION

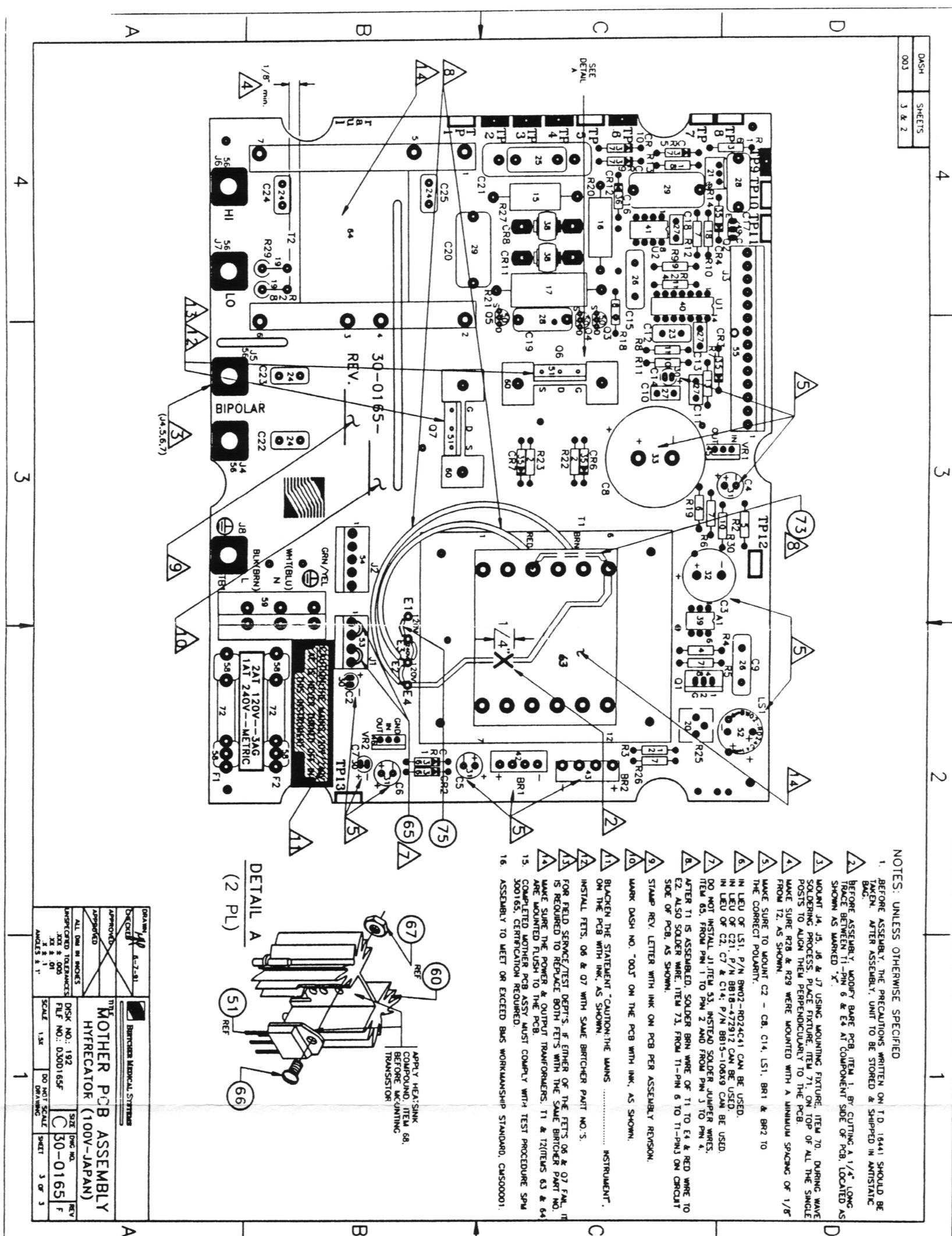
	-001	-004	-002	-003
	113VUL/CSA	230V-EXPORT	230V - TUV/IEC	100V - JPN

ITEM	REQ'D	PART NO.	REQ'D	PART NO.	REQ'D	PART NO.	REQ'D	PART NO.
53	1	BL05-0097	1	BL05-0097	1	BL05-0097	N/A	
54	4	BS02-0009	4	BS02-0009	2	BS02-0017	4	BS02-0009
55	1	05-0153-001	1	05-0153-001	1	BR05-0008	1	05-0154-001
56	1	HAD1-0006	N/A	N/A	N/A	N/A	1	HAD1-0006
57	2	BS04-0200ASD	2	BS04-0100ASD	2	BS04-0100CSA	2	BS04-0200ASD
58	2	BS04-0200ASD	2	BS04-0100ASD	2	BS04-0100CSA	2	BS04-0200ASD
59	1	N/A	N/A	N/A	N/A	N/A	1.25	08-0442-001
75	N/A	5	HAD1-0006	.5	HAD1-0006	.5	HAD1-0006	

DRAWN	RECD
BAKER	BOOTHUM MEDICAL SYSTEMS
APPROVED	
ALL DIM. IN INCHES	
UNSPECIFIED TOLERANCES	
ALL DIM. IN INCHES	
REF. NO.: A192	
FILE NO.: D308165F	
SCALE: 1:1	DO NOT SCALE
AMENTS 2:1	DRAWING SHEET 2 OF 3

A

ITEM/	PART NUMBER	DESCRIPTION	REF. DESIGNATOR
1	06-0165-001	P.C. BOARD REV "B"	
2	01-0166-100	RESISTOR, 10Ω 1/4W 5% CARBON	R22.23
3	01-0166-101	RESISTOR, 100Ω 1/4W 5% CARBON	R16
4	01-0166-151	RESISTOR, 150Ω 1/4W 5% CARBON	R4
5	01-0166-471	RESISTOR, 470Ω 1/4W 5% CARBON	R2
6	01-0166-621	RESISTOR, 620Ω 1/4W 5% CARBON	R19
7	01-0166-192	RESISTOR, 1KΩ 1/4W 5% CARBON	R5.6.12.26
8	01-0166-222	RESISTOR, 2.2KΩ 1/4W 5% CARBON	R18
9	01-0166-272	RESISTOR, 2.7KΩ 1/4W 5% CARBON	R9
10	01-0166-103	RESISTOR, 10KΩ 1/4W 5% CARBON	R11.30
11	01-0166-133	RESISTOR, 13KΩ 1/4W 5% CARBON	R8.24
12	01-0166-223	RESISTOR, 22KΩ 1/4W 5% CARBON	R3
13	01-0166-473	RESISTOR, 47KΩ 1/4W 5% CARBON	R7
14			
15	BL14-471J	RESISTOR, 470Ω 1W 5% CARBON	R27
16	BL15-221J	RESISTOR, 220Ω 2W 5% CARBON	R20
17	01-0654-130	RESISTOR, 15Ω 5W 10% CARBON	R21
18	01-0654-472	RESISTOR, 47KΩ 1/4W 5% CARBON	R10.13
19	BL24-201J	RESISTOR, 200Ω 5W 5% CARBON	R28.29
20	BL17-50216-00	POTENTIOMETER, 5K 1T	R25
21	BL18-103W	POTENTIOMETER, 10K 25T	R14
22			
23	01-0655-181	CAPACITOR, 180 pF 500V DIPPED MICA	C12
24			



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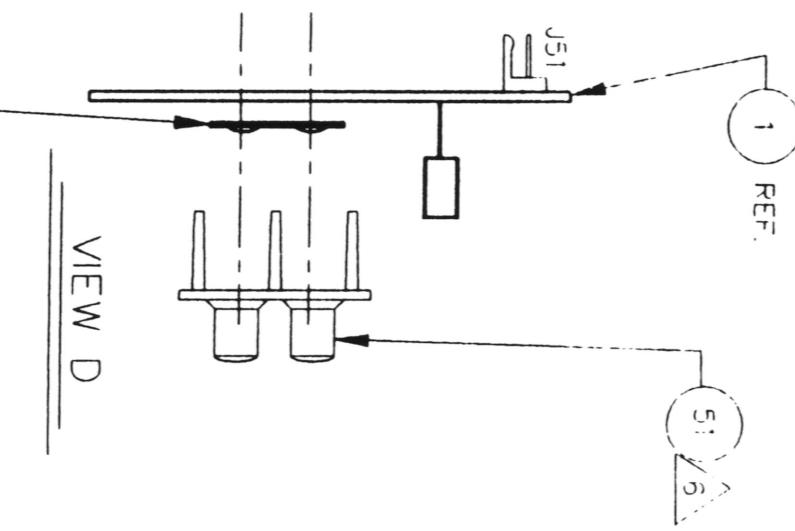
001

001

ITEM QTY	PART NUMBER	DESCRIPTION	REFERENCE DES.
1	1	06-0164-001	DISPLAY P.C. BOARD
2	1	01-0166-512	RESISTOR 5.1K Ω 1/4W 5% CARBON
3	1	01-0166-432	RESISTOR 4.3K Ω 1/4W 5% CARBON
4	3	01-0166-472	RESISTOR 4.7K Ω 1/4W 5% CARBON
5	1	01-0166-302	RESISTOR 3K Ω 1/4W 5% CARBON
6	1	01-0166-912	RESISTOR 9.1K Ω 1/4W 5% CARBON
7	11	01-0166-103	RESISTOR 10K Ω 1/4W 5% CARBON
8	2	01-0166-223	RESISTOR 22K Ω 1/4W 5% CARBON
9	2	01-0166-473	RESISTOR 47K Ω 1/4W 5% CARBON
10	1	01-0166-683	RESISTOR 68K Ω 1/4W 5% CARBON
11	2	01-0166-104	RESISTOR 100K Ω 1/4W 5% CARBON
12	2	01-0166-105	RESISTOR 1M Ω 1/4W 5% CARBON
13	1	01-0166-474	RESISTOR 470K Ω 1/4W 5% CARBON
14	1	01-0166-102	RESISTOR 1K Ω 1/4W 5% CARBON
15	1	BL31-202M	POT 2K Ω 1T
16	1	BL18-103W	POT 10K Ω 25T
17	1	01-0656-001	RESISTOR NETWORK 150 Ω DIP 16L
18	2	N5345-2134	RESISTOR 13K Ω 1/4W 5% CARBON
19	2	BB14-330J	CAP 33PF 500V
20	3	BB19-103K	CAP .01 μ F 63V
21	1	BB19-223K	CAP .022 μ F 63V
22	11	BB19-104K	CAP .1 μ F 63V
23	2	BB19-334K	CAP .33 μ F 63V
24	2	BB19-474K	CAP .47 μ F 63V
25	2	BB23-107M	CAP 100 μ F 35V
26			C57.64
27	6	01-0029-000	DIODE IN914B
28	1	BL02-PY4504K	LED GREEN
29			DS51
30	1	01-0230-000	I.C. 4040 16L
31	2	BL10-358N	I.C. LM358N 8L
32	1	01-0198-000	I.C. CD4071B 14L
33	1	01-0200-000	I.C. CD4018FX 14L
34	1	20-0181-001	EPROM, PROGRAMMED, 7-797
35	1	01-0657-001	I.C. DAC0800LCN 16L
36	1	BL15-4094BCN	I.C. CD4094BCN 16L
37	1	01-0651-001	I.C. 4499 18L

REV	ECO	SEE SHEET 1	DESCRIPTION	DATE	APPROVED
PARTS LIST					
DISPLAY PCB ASSY					
DRAWN  8-13-91		BIRTCHEER MEDICAL SYSTEMS			
		50 Technology Drive Irvine, California 92718			
CHECKED					
APPROVED					
APPROVED					
ALL DIM IN INCHES		DISK NO.:	194	SIZE	DWG NO.
UNSPECIFIED TOLERANCES		FILE NO.:	D300164B	B	30-0164
.XXX ± .005		SCALE	NONE	DO NOT SCALE	SHEET 2 OF 3
.XX ± .01					
.X ± .1					
ANGLES ± 1°					

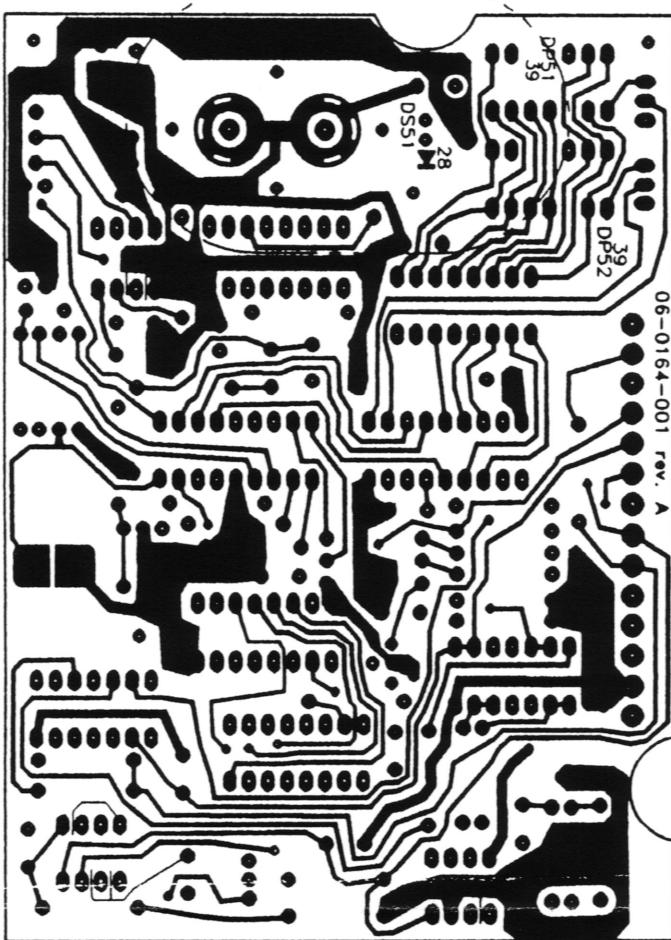
CENTER THE DOMES —
TO THE PADS USING —
THE GUIDE ARC.



VIEW D

52.
REF.

1.
REF.

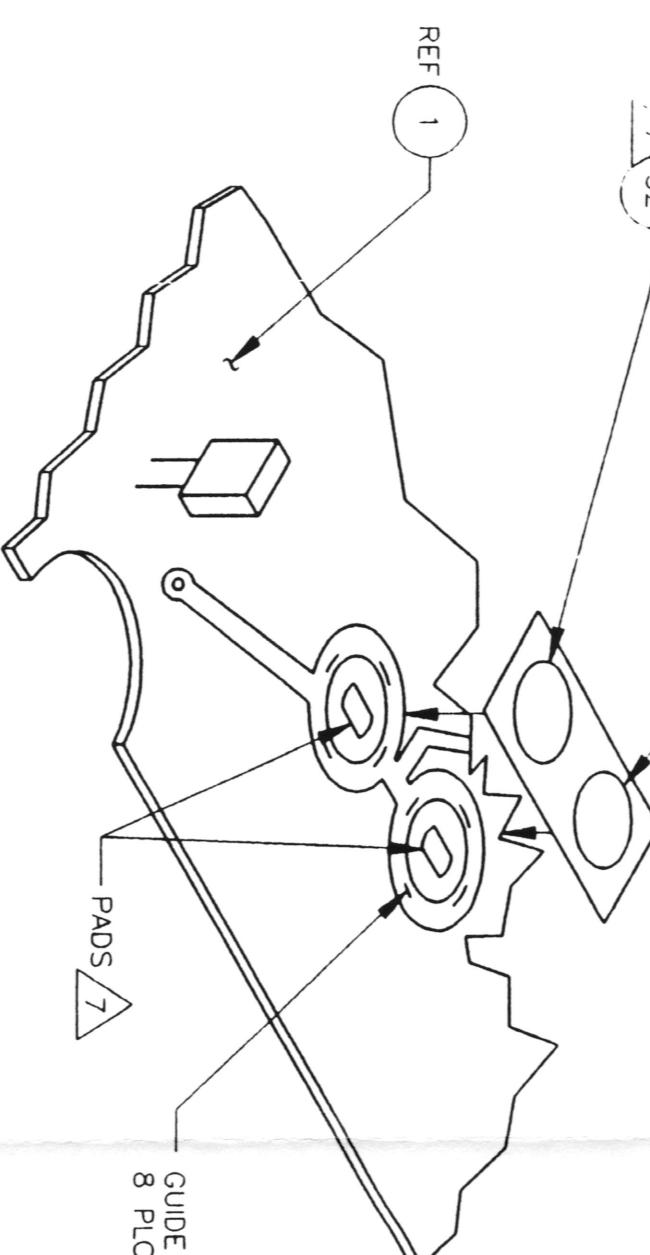


5 VIEW C
CIRCUIT SIDE

1.
REF.

52.
REF.

1.
REF.



GUIDE ARC (NO COPPER/TIN)
8 PLCS.

5.
REF.

5.
REF.

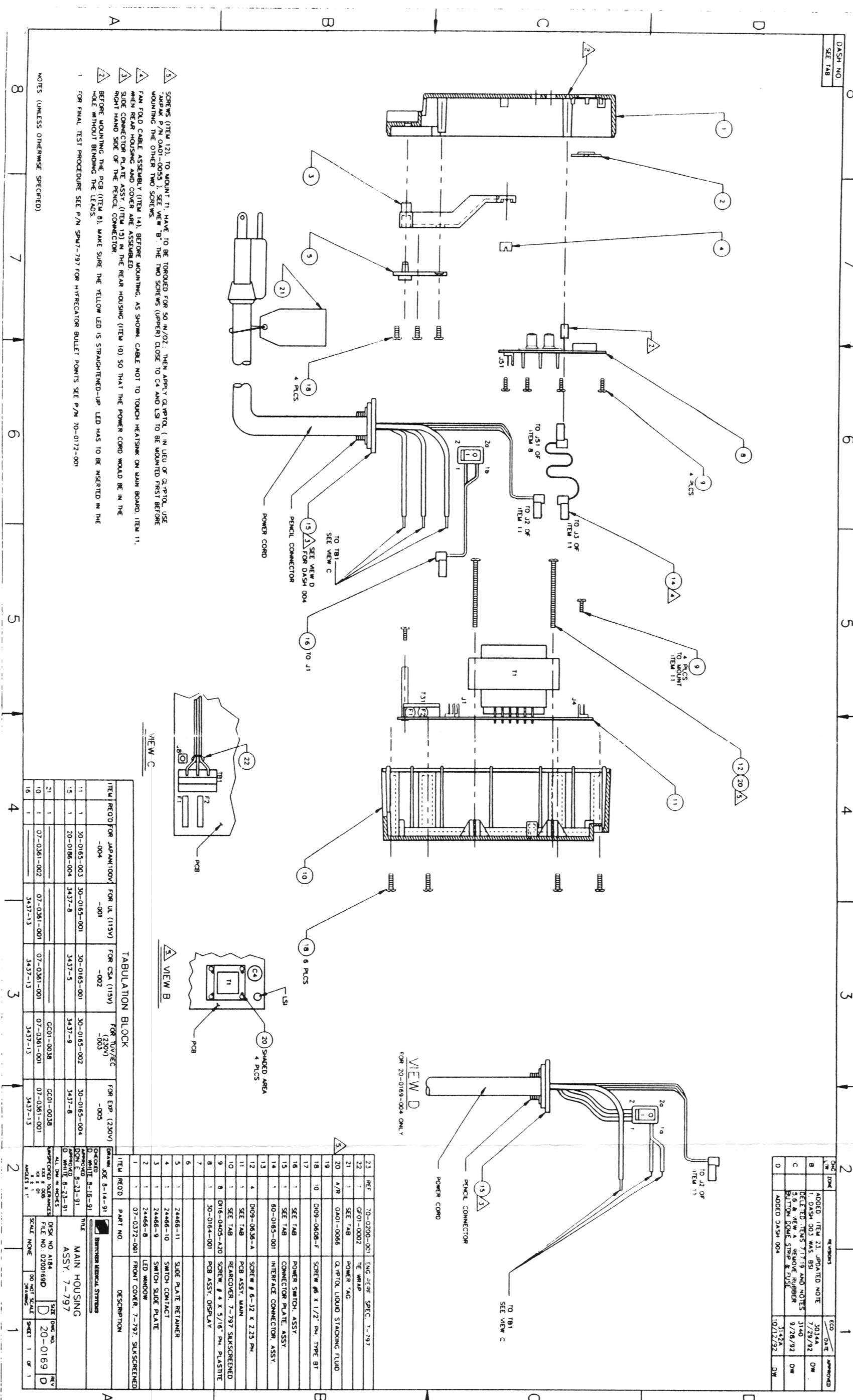
SEE VIEW C

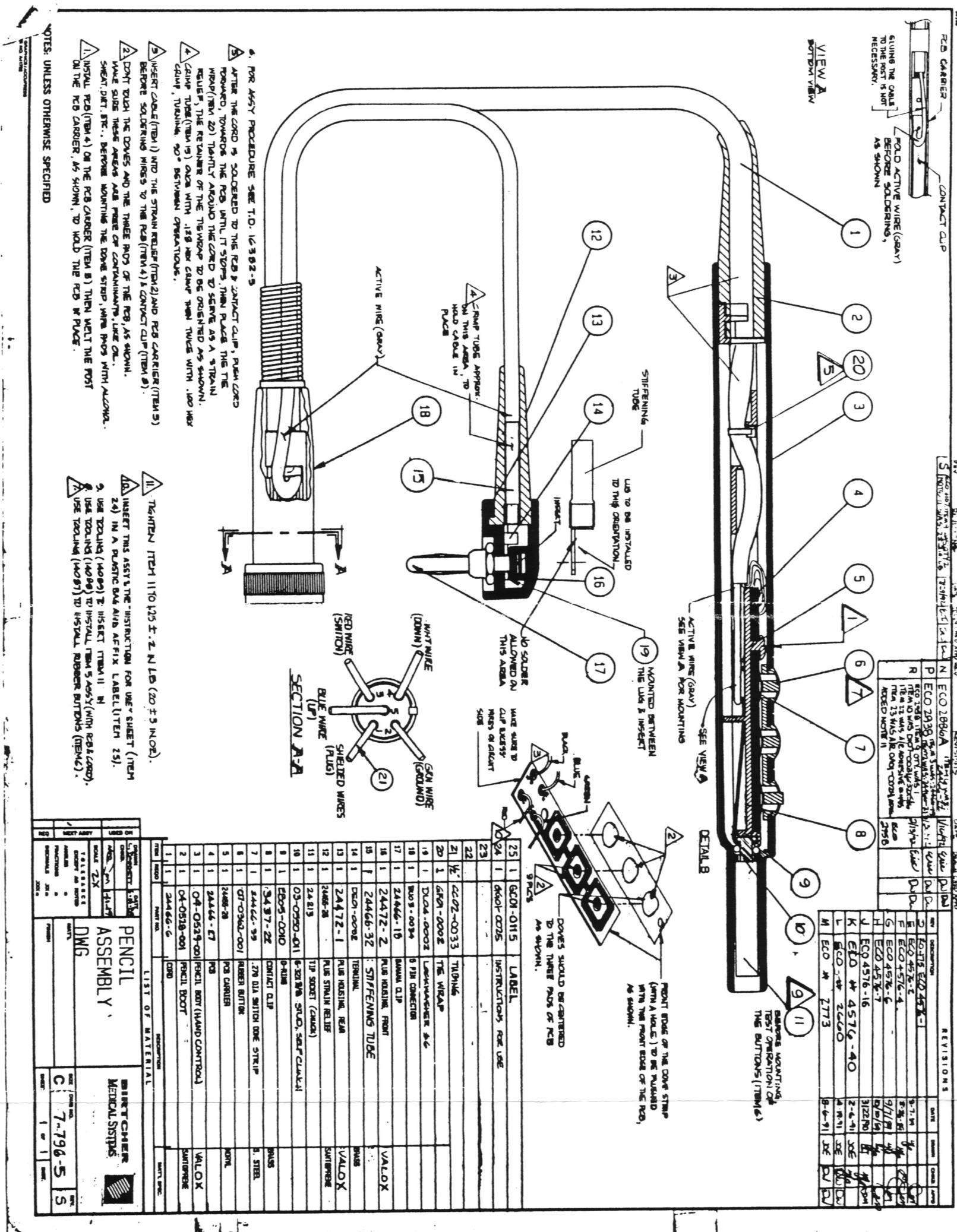
D CIRCUIT SIDE SHOWN

DRAWN	MJ	9/8/92
CHECKED		
APPROVED		
APPROVED		
ALL DIM IN INCHES		
UNSPECIFIED TOLERANCES		
XXX ± .005		
.XX ± .01		
.X ± .1		
ANGLES ± 1°		
DISK NO.: 192	SIZE	DWG NO.
FILE NO.: D30B164B	B	30-0164
SCALE	None	DO NOT SCALE
		SHEET 3 OF 3

50 Technology Drive
Irvine, California 92718

PCB ASSEMBLY
HYFRECATOR DISPLAY





ITEM	DESCRIPTION	QTY	ITEM	DESCRIPTION	QTY
P	ECO 2A36	1	N	ECO 2B80A	1
R	ECO 1A8	1	O	ECO 1A8	1
S	ECO 4576-1	1	P	ECO 4576-2	1
F	ECO 4576-4	1	Q	ECO 4576-5	1
G	ECO 4576-6	1	R	ECO 4576-7	1
H	ECO 4576-8	1	S	ECO 4576-9	1
J	ECO 4576-10	1	T	ECO 4576-11	1
K	ECO 4576-12	1	U	ECO 4576-13	1
L	ECO 4576-14	1	V	ECO 4576-15	1
M	ECO 4576-16	1	W	ECO 4576-17	1
L	ECO 4576-18	1	X	ECO 4576-19	1
M	ECO 4576-20	1	Y	ECO 4576-21	1
N	ECO 4576-22	1	Z	ECO 4576-23	1